

PB81-910218

SELECTED
WATER
RESOURCES
ABSTRACTS



VOLUME 14, NUMBER 18
SEPTEMBER 15, 1981

W81-03951 -- W81-04300
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 14, NUMBER 18
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Select Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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01 NATURE OF WATER

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

EFFECT OF SPATIAL VARIABILITY ON THE SIMULATION OF OVERLAND AND CHANNEL FLOW.

Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Agricultural Engineering. V. O. Shanholtz, B. B. Ross, and J. C. Carr. *Transactions of the ASAE*, Vol 24, No 1, p 124-133, 138, January/February, 1981. 21 Fig, 8 Tab, 26 Ref. OWRT-A-044-VA(4) and A-083-VA(2).

Descriptors: *Storms, *Model studies, *Hydrology, Spatial distribution, Variability, Distribution, Simulation, Channel flow, Overland flow, Streamflow, Rainfall-runoff relationships.

The purpose of this paper is to illustrate how the finite element numerical technique is used to define a hydrologic modeling structure with sufficient flexibility to incorporate the detailed spatiotemporal variations that often exist in watersheds. Specific emphasis is placed on examples to illustrate how various changes affect the output response. A hypothetical watershed is used to highlight specific parameters. A natural watershed is also used to provide insight into the effect of data resolution on model predictability. In the natural watershed the effects of aggregation of soils, land use and topographic descriptors are particularly pronounced. It was noted in general that error in prediction became progressively worse as the level of resolution of the data was decreased. Gross errors were noted when the area was subdivided into one hydrologic response unit and different rainfall distributions were used to simulate discharge. Peak discharge varied from zero to about 28 mm/h. A major advantage of a spatially responsive modeling structure is the ability to simulate the effect of various management alternatives. (Baker-FRC) W81-03959

MODELING DAILY RIVER FLOWS WITH PRECIPITATION INPUT.

Wisconsin Univ., Madison. Dept. of Statistics.

R. B. Miller, W. Bell, O. Ferreiro, and R. Y.-Y. Wang.

Water Resources Research, Vol 17, No 1, p 209-215, February, 1981. 4 Fig, 10 Tab, 17 Ref. OWRT-B-103-WISC(3).

Descriptors: *Rainfall-runoff relationships, *Rivers, *Flow measurement, Regression analysis, Model studies, Streamflow, Mathematical studies.

Daily river flows were modeled using rainfall data. A regression model produced better predictions than did a univariate time series model. The data supported the inclusion of second degree polynomial terms for precipitation in the model, exploiting the apparent nonlinearity of the relationship between precipitation and river flow. When simulated river flow data were compared with measured data from the Menomonee River, Milwaukee, Wisconsin, agreement was good. Variations in model parameters have greater impacts on flow characteristics than do variations in rainfall, showing that the estimations of parameters using techniques based on random coefficient models are probably more precise than estimations based on ordinary least squares. (Cassar-FRC) W81-03961

A FUNCTIONAL CLASSIFICATION OF WETLANDS,

Georgia Univ., Athens. Inst. of Ecology.

E. P. Odum.

In: *Proceedings, U.S. Fish and Wildlife Service Workshop on Coastal Ecosystems of the Southeastern United States*, Big Pine Key, Florida, 18-22 February 1980. Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/79, February, 1981. p 4-9, 3 Fig, 4 Ref.

Descriptors: *Wetlands, *Environmental effects, *Ecosystems, Flow, Energy balance, Eutrophication, Water pollution, Detritus, Organic matter, Resources management, *Marsh management.

A holistic approach to impact assessment and management of a wetland ecosystem must include consideration of the input and output environments. In wetlands, water flow acts as an energy subsidy which enhances the performance of the system in many situations. In other circumstances the input becomes a stress which reduces the potential productivity of the system. A classification can be devised based upon the input environment. To the natural water regime categories are added classifications for eutrophicated and chemically stressful inflows in each of the habitat types. Identification of the input environment in relation to the wetlands system is extremely important in terms of estimating the impact of a manmade disturbance. It often is advisable to consider the output environment. The output feature of major importance concerns the nature and extent of net export of energy and materials from the wetland system. Exports of organic matter, nutrients, or toxic chemicals not only affect the downstream adjacent system, but also the wetland itself. A preliminary classification might include several situations in regard to exports as follows: detritus with a net export of organic matter; grazing systems with an export of nutrients; grazing systems without a net export of organic matter or nutrients; eutrophicated systems with a pass-through export of organic matter or nutrients; and stressed systems with a pass-through export of toxic materials. (Moore-SRC) W81-04020

DIFFERENCES BETWEEN SOUTH ATLANTIC AND GULF COAST MARSHES,

Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.

A. A. de la Cruz.

In: *Proceedings, U.S. Fish and Wildlife Service Workshop on Coastal Ecosystems of the Southeastern United States*, Big Pine Key, Florida, 18-22 February 1980. Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/79, February, 1981. p 10-20, 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Coastal marshes, *Hydrodynamics, *Hydrological regime, *Estuaries, Tidal effects, Salinity, Ecology, Storm surges, Weather patterns, Deltas, Lagoons, Wetlands, Barrier islands, Tide lands, Marsh plants, Comparison studies, South Atlantic coast marshes, Gulf coast marshes.

The one factor that determines the biological, ecological, and chemical differences between the South Atlantic and Gulf Coast marshes is water, both the hydrological processes and hydrodynamic regimes that characterize each region. Gulf Coast marshes are developed primarily on deltaic formations constructed on alluvial deposits created by several major river systems, while the South Atlantic marshes are basically formed on estuarine and lagoonal soft silt deposits bridging the barrier islands and the mainland shorelines. Tides in the South Atlantic are normally semidiurnal with fluctuations of more than 2.0 m; meteorological phenomena are more stable with fewer major storm surges. In the Gulf, tides are generally diurnal with maximum fluctuation of 0.3 m. Prevailing local weather conditions, seasonally changing major wind directions, high energy summer tropical storms, and gulf basin natural oscillations complicate the hydrodynamics of the Gulf marsh system. The peculiar hydrology of the Gulf, with the great freshwater input dominated by the Mississippi River influences salinity, producing a more diverse vegetation structure and seasonal fluxes of materials into the Gulf Coast marsh-estuary. (Moore-SRC) W81-04021

IDENTIFICATION OF UNIT HYDROGRAPHS FROM MULTI-EVENT ANALYSIS,

Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.

J. A. Mawdsley, and A. F. Tagg.

Journal of Hydrology, Vol 49, No 3/4, p 315-317, February, 1981. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Hydrographs, *Rainfall-runoff relationships, Hydrography, Hydrology, Hydrologic data, Hydrologic equation, Hydrograph analysis, Runoff, River Tyne, England.

The multi-event procedure was employed with data from two catchments on the River Tyne, England, to determine whether the accuracy of prediction of the quick-response runoff was improved by using this method as opposed to using the unit hydrograph found by the traditional approach of smoothing and then averaging the individual unit hydrographs. For up to seven events the efficiencies of prediction, using these unit hydrographs, were compared with efficiencies using unit hydrographs traditionally obtained. The efficiencies by using the multi-event unit hydrograph were slightly higher than for the FSR method. However, this difference was not seen to be a significant one. The significant factor seems to be the advantages of the technique which occur when identifying the unit hydrograph. Also, the multi-event unit hydrograph rarely possessed negative ordinates, and the area under the curve was very close to 1 mm, as required from the conservation of mass. (Baker-FRC) W81-04077

ANALYSIS OF HYDROLOGIC CHARACTERISTICS FROM RUNOFF DATA - A HYDROLOGIC INVERSE PROBLEM,

Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.

M. Hino, and M. Hasebe.

Journal of Hydrology, Vol 49, No 3/4, p 287-313, February, 1981. 15 Fig, 3 Tab, 13 Ref.

Descriptors: *Rainfall-runoff relationships, Watersheds, Runoff, Rainfall, Precipitation, Hydrology, *Time series analysis, Model studies.

The characteristics of hydrologic basins as well as rainfall were derived only from daily runoff data. In order to accomplish this the time series of daily runoff were separated into components of surface flow, interflow, and groundwater flow by numerical filters. The cut-off infrequencies were determined from the order of magnitude comparison of autoregressive coefficients of runoff data and confirmed by the coherence gap in rainfall-runoff data. The daily rainfall was assumed to be of white noise, and thus the time series of each component was separated and fitted to the autoregressive model from which the hydrologic impulse response characteristics were determined. Time series of the daily rainfall were inversely generated from the original time series of the daily runoff and the coefficients of the autoregressive model determined as noted above. The estimated time series of rainfall agree relatively well with the real, but screened, rainfall data. A nonlinear separation law of effective rainfall into several rainfall components was estimated. (Baker-FRC) W81-04078

INTERPRETATION OF RECESSION FLOW,

Bristol Univ. (England). Dept. of Geography.

For primary bibliographic entry see Field 2E. W81-04199

ISOLATION AND ENUMERATION OF LISTERIA MONOCYTOGENES FROM SEWAGE, SEWAGE SLUDGE AND RIVER WATER,

Yorkshire Water Authority (England).

J. Watkins, and K. P. Sleath.

Journal of Applied Bacteriology, Vol 50, No 1, p 1-9, 1981. 1 Fig, 7 Tab, 25 Ref.

Descriptors: *Pathogens, *Sewage bacteria, *Sludge, Land disposal, Waste water, Liquid sludge, Sludge disposal, Sludge utilization, Rivers, Public health, Health hazards.

The increasing demand for water for consumption and recreational use and the disposal of sewage sludge on to land has resulted in investigations of the types, numbers, and survival of potentially pathogenic organisms. A method developed for the isolation and enumeration of *Listeria monocytogenes* has been used to study the distribution of this pathogenic organism in water and on land contaminated by sewage. *L. monocytogenes* in sewage, sewage sludge, and river water was isolated by enrichment at 4°C with subculture and enrichment in thiocyanate, nalidixic acid broth,

Field 2—WATER CYCLE

Group 2A—General

and plating on to tryptose agar. The organism was isolated from every sample of sewage, river water, and sewage sludge examined. Not only were *L. monocytogenes* present in considerable numbers, often in excess of *Salmonella* spp., but survival time studies for sewage sludge sprayed on to land showed that there was no detectable reduction in numbers during 8 weeks following spraying. Hemolysis tests on horse blood agar with strains isolated from these samples showed that 58 percent were hemolytic, 34 percent were weakly hemolytic, and 13 percent were non-hemolytic. Earlier tests with embryonated hens eggs demonstrated that all hemolytic strains were virulent with respect to embryo death. The presence of this pathogenic organism in sewage sludge and river water should be regarded as a potential public hazard warranting further investigation. (Carroll-FRC)
W81-04219

2B. Precipitation

THE DISTRIBUTION OF HYDROLOGICALLY EFFECTIVE RAINFALL INCIDENT ON SLOPING GROUND,
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
D. Sharon.
Journal of Hydrology, Vol 46, No 112, p 165-188, March, 1980. 13 Fig, 4 Tab, 22 Ref.

Descriptors: *Precipitation, *Slope gages, *Topography, Statistics, Theoretical analysis, Rainfall, Wind, Gages, Rain gages, Gaging stations, Mathematical models, Terrain analysis, Velocity, Wind velocity.

A trigonometric model is proposed which corrects raingage readings to account for variability caused by sloping ground. The model applies to conventional raingages with horizontal orifices, and can correct for combinations of 40 to 60 degree inclines and varied wind velocities. It is based on the assumption that the inclination of drop trajectories is constant in time, space, and over the drop spectrum. Elements of the model include the intensity of rainfall, given the normal storm vector, and the angle between the storm vector and the plane of the gage orifice. This model was field tested in a small, first-order watershed in Israel. Raingage observations were made following 15 storms with over 3 mm interception and relatively steady wind conditions. Results confirm the applicability of the model and its relatively small associated error. However, the model is limited to areas where the azimuth and inclination of drops can be specified, and may be unsuitable for mountainous areas. (Titus-FRC)
W81-04198

SOME STUDIES ON MOISTURE CONDITIONS IN THE SOUTHERN HEMISPHERE,
Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).
Y. Viswanadham, N. J. M. Rao, and G. S. S. Nunes.
Tellus, Vol 32, No 2, p 131-142, April, 1980. 13 Fig, 36 Ref.

Descriptors: *Precipitation, *Seasonal variation, *Humidity, Moisture, Climatology, *Southern hemisphere, Water vapor, Atmospheric water, Mathematical studies, Rainfall.

A systematic study of the seasonal humidity conditions for the entire Southern Hemisphere was conducted using the midseason months of the four seasons of the year. Vertical cross-sections of the seasonal mean atmospheric humidity conditions on a planetary scale were formulated, and the fields of mean precipitable water content were analyzed. Comparisons were made between zonally averaged values of the various quantities at several levels and results of previous evaluations. The structure of these fields in relation to the general circulation patterns of the atmosphere was examined, and the precipitation efficiencies for South America, Africa and Australia were approximated. Winter and summer vertical cross-sections of atmospheric cooling rates were also investigated. These find-

ings will be useful in future studies of large-scale atmospheric processes as well as in preparing climatic normals of water vapor content for the Southern Hemisphere. (Geiger-FRC)
W81-04228

APPLICATION OF A SIMPLE DIAGNOSTIC CLOUD MODEL TO THE 20 MAY 1977 STORMS OVER THE OKLAHOMA MESONETWORK,

Wisconsin Univ.-Milwaukee.

For primary bibliographic entry see Field 7B.

W81-04232

FORECASTING AND RESEARCH ON SEVERE STORMS IN CHINA-A SUMMARY OF TWO SEMINARS,

National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs. J. H. Golden.

Bulletin of the American Meteorological Society, Vol 61, No 1, p 7-23, January, 1980. 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Storm structure, *Forecasting, *Weather forecasting, Radar, Hail, Rain, Weather patterns, Storms, Meteorology, Data collection, China.

Two seminars on severe storm research in China were presented by Chinese investigators at the National Severe Storms Laboratory, Norman, Oklahoma, on June 6, 1979. The first seminar surveyed severe convective weather research projects in China. A weather radar system which includes over 100 radar units is used to collect data on the identification of hailstorms and their structure. In general, radar indicators of hailstorms are 40 dB(Z) in reflectivity with a storm height of over 11 km. Research indicates that hailstorms have three structures: multicell, super cell, and ordinary cell. Warning and forecasting of severe hailstorms and rainstorms has been attempted in China. The second presentation surveyed research conducted on severe storms at the Institute of Atmospheric Physics. Weather patterns are presented for typhoons, significant convective storms and rainfall, conditions favoring heavy rains, flash floods, etc. Some modeling research is presented. Again, questions and answers are included. (Small-FRC)
W81-04287

2C. Snow, Ice, and Frost

HEAT AND MASS TRANSFER IN A FREEZING UNSATURATED POROUS MEDIUM,

Department of Agriculture, Swift Current (Saskatchewan). Research Station.

Y-W. Jame, and D. I. Norum.

Water Resources Research, Vol 16, No 4, p 811-819, August, 1980. 11 Fig, 27 Ref.

Descriptors: *Freezing, *Porous media, *Heat transfer, *Mass transfer, Ice formation, Frozen ground, Soil water, Numerical analysis, Mathematical analysis, Simulation analysis.

Coupled heat and mass transfer in horizontal porous medium columns with one end below 0°C were studied by numerical simulation and laboratory experiments. Harlan's equations (1973) and the finite difference method with the Crank-Nicholson scheme were used to solve the model. The solution produces temperature, liquid water content, and ice content profiles along the column as a function of time. Comparisons of experimental results with simulated results show that Harlan's model, with modifications in the hydraulic conductivity of the frozen medium, can be used to simulate numerically the coupled heat and mass transfer process when ice lensing does not occur. Substantial differences are seen when the temperature profiles and the depth of freezing obtained from the model by considering simultaneous heat and mass transfer are compared to those obtained by assuming water movement in soil does not occur and only the heat transfer equation is used. It is important to consider the effect of mass transfer on the thermal state of soil when dealing with freezing and thawing in soils. (Cassar-FRC)
W81-04076

W81-04110

2D. Evaporation and Transpiration

MEASUREMENTS OF DISCHARGES FROM SOME OF THE MOUND SPRINGS IN THE DESERT OF NORTHERN SOUTH AUSTRALIA,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.

J. W. Holmes, A. F. Williams, J. W. Hall, and C. J. Henschke.

Journal of Hydrology, Vol 49, No 3/4, p 329-339, February, 1981. 7 Fig, 3 Tab, 3 Ref.

Descriptors: *Springs, *Evaporation rate, Hydrologic budget, *Australia, Deserts, Arid lands, Emerald Spring, Warburton Spring, Salts, Hydrology.

During November 1977 fifteen springs were measured in the Marree-Oodnadatta district of the South Australian desert. The area contributing water lost by evaporation was assessed on the ground as being that area covered by open water and by swamp vegetation. The data demonstrated that the areas and the associated spring discharges were correlated, as had been expected, but that there were also some large anomalies. Nearly all the springs in the area with the notable exception of Emerald Spring and Warburton Spring had data which would indicate an evaporation rate of significantly larger than 10 mm/day. However, previous work indicates an evaporation rate of around 6.5 mm/day. During May 1978 a detailed study of Emerald and Warburton Springs was carried out. The contour map of depth to the water table in the soil surrounding the two swamps of the springs enabled better calculations of the evaporative dissipation of the water to be made. Salt accumulation was noted, and it was suggested in the case of Emerald Spring swamp that a salt halo had been left at the outer rim of the limit of spread of the water. In Warburton Spring swamp the salt distribution could not be explained on similar reasons. (Baker-FRC)
W81-04075

RAINFALL INTERCEPTION IN A MULTI-STORIED, EVERGREEN MIXED FOREST: ESTIMATES USING GASH'S ANALYTICAL MODEL,

Forest Research Inst. Christchurch (New Zealand).

A. J. Pearce, and L. K. Rowe.

Journal of Hydrology, Vol 49, No 3/4, p 341-353, February, 1981. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Interception loss, *Model testing, Rainstorms, Water loss, *Storm runoff, Storm water, Storms, Rainfall, Evaporation.

Gash's analytical model was used with a two-year sequence of storm-rainfall and daily-rainfall amounts to calculate estimated interception losses. A comparison was then made between these calculated values and observed interception losses. Storm rainfall-based estimates averaged 9% greater than observed losses. Daily rainfall-based estimates averaged 26% greater than observed losses. This latter finding was primarily due to the number of storms being overestimated by substituting the sequence of daily rainfalls for the sequence of storm rainfalls. Thus, an overestimation was obtained of the evaporation from canopy storage after rainfall. When the estimated storm number was adjusted in a manner consistent with the physical basis of the model, daily rainfall-based estimates averaged 3% greater than storm rainfall-based estimates and 12% greater than observed interception losses. (Baker-FRC)
W81-04076

TRANSPIRATION RATE OF DOUGLAS FIR TREES IN THINNED AND UNTINNED STANDS,

British Columbia Univ., Vancouver. Dept. of Soil Science.

T. A. Black, C. S. Tan, and J. U. Nyamah.

Canadian Journal of Soil Science, Vol 60, No 4, p

Groundwater—Group 2F

625-631, November, 1980. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Trees, *Transpiration, Forests, Forest hydrology, Land management, Soil moisture retention, Forest soil, Soil types, Water loss, Transpiration ratio, *Fir trees.

A simple procedure is explained for estimating the transpiration rates of individual trees, combining soil water balance measurements of the stand evapotranspiration rate with a simple vapor diffusion model that requires occasional, intensive measurements of stomatal conductance to be made on both trees and understory vegetation. Weekly average transpiration rates of 22 yr old Douglas fir trees measured in a thinned stand during sunny July weather ranged from 23.6 to 4.9 liters/tree/day. Transpiration rates in the thinned stand were very similar to those of trees in a nearby unthinned stand with virtually no understory vegetation. It was concluded that over a fairly wide range of values of extractable soil water in the root zone, the transpiration rate of individual trees was affected by the understory. At low values of extractable soil water, the salal understory had a competitive advantage over the Douglas fir, as the salal accounted for more than one-half of the stand evapotranspiration rate. Competition for soil water by the salal understory after thinning is considered a reason why the diameter growth rate in thinned stands was only slightly greater than that in the unthinned stand. It is suggested that thinning practices that reduce or prevent the growth of understory vegetation would result in more efficient use of soil water by trees in areas where there is not an abundance of soil water. (Titus-FRC)
W81-03953

ical models, Urban runoff, Infiltration, Surface-groundwater relationships, Horton's Law, Drainage, Watersheds, *Illinois Urban Drainage area.

The single event version of the Illinois Urban Drainage Area Simulator Model (ILLUDAS) has been modified to operate as a continuous model. A daily soil moisture and initial abstraction accounting procedure has been developed and integrated with the original Horton infiltration model. In addition, new routing options were added. An optimization procedure for calibrating the model has been incorporated. The model is capable of reasonable accurate simulation of events in which abstractions are not a major part of total rainfall. The modified version of the model offers the advantage of having accuracy without large computer storage. It utilized a representation of the catchment that has physical meaning to the user, and has potential application for evaluating design storms. (Titus-FRC)
W81-03953

ESTIMATING CORRELATIONS IN MULTIVARIATE STREAMFLOW MODELS

Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.

J. R. Stedinger.

Water Resources Research, Vol 17, No 1, p 200-208, February, 1981. 1 Fig, 11 Tab, 21 Ref. OWRT-A-085-NY(4).

Descriptors: *Streamflow, *Model studies, *Correlation analysis, Statistical methods, Mathematical studies, Synthetic hydrology, Hydrology, Monte Carlo method, Stochastic processes, Parametric hydrology.

Two basically different approaches have been used to estimate streamflow model parameters. A Monte Carlo study was performed to evaluate alternative estimators of the cross correlation between autocorrelated streamflow series and the lag 1 autocorrelation of a single series when some or all of the flows have a log normal distribution. It was found that the practice of directly estimating the cross covariances and autocorrelation of the logarithms of the observations can give better estimation of the true cross correlation and autocorrelation of the flows than do the sample product-moment estimators. It might be advantageous to prewhiten the log of the transformed series before calculating the cross covariance if the true cross correlation is less than 0.50 and the lag 1 autocorrelation of the observations is 0.50 or greater. Unbiasing the estimate of the autocorrelation of the logarithm of the observed flows is advantageous if the true autocorrelation is 0.60 or larger. Efficient streamflow parameter procedures need to be combined with other analyses which consider the uncertainty in the fitted parameters of stochastic streamflow models. (Cassar-FRC)
W81-03955

TRANSPORT OF RESISTANCE-LABELED ESCHERICHIA COLI STRAINS THROUGH A TRANSITION BETWEEN TWO SOILS IN A TOPOGRAPHIC SEQUENCE

Oregon State Univ., Corvallis. Dept. of Soil Science.

For primary bibliographic entry see Field 5B.
W81-03956

EFFECT OF SPATIAL VARIABILITY ON THE SIMULATION OF OVERLAND AND CHANNEL FLOW

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 2A.
W81-03959

NOTE ON THE TIME TO FLOOD EXCEDENCE

Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.

For primary bibliographic entry see Field 7B.
W81-04073

INTERPRETATION OF RECESSION FLOW

Bristol Univ., (England). Dept. of Geography.

M. G. Anderson, and T. P. Burt.

Journal of Hydrology, Vol 46, No 12, p 89-101, March, 1980. 8 Fig, 2 Tab, 17 Ref.

Descriptors: *Graphical analysis, *Prediction, *Runoff, *Recession, *Drainage, Laboratories, Darcy's law, Flow, Runoff plot, Field investigations, Groundwater runoff, Surface runoff, Storage, Basins, Discharge hydrographs.

Various attempts at interpreting recession flow using graphical techniques are reviewed. Data derived from a laboratory slope drainage experiment and from an instrumented catchment are plotted using the same graphical presentations. These data are also interpreted using predictions based upon Darcy's law. Results indicate that graphical techniques can falsely interpret the factors controlling recession, by producing inaccurate breaks of slope. The use of recession flow graphs has potential application in predicting low flows. (Titus-FRC)
W81-04199

2F. Groundwater

U FINGERPRINTS IN GROUNDWATER

J. Kronfeld, and J. C. Vogel.

Nuclear Active (Pretoria), No 22, p 30-32, 1980. 5 Fig, 11 Ref.

Descriptors: *Uranium, *Uranium radioisotopes, *South Africa, *Spectral analysis, *Groundwater dating, Radioactive dating, Geological surveys, Aquifers, Dolomite, Spectrometry, Radioisotopes, Isotopic tracers, Water sampling, Water analysis.

An alpha-particle spectrometry system for measuring uranium and thorium isotopes in groundwater was used to analyze uranium fractionation in the Transvaal dolomite aquifer in South Africa. The system can characterize specific waters on the basis of their uranium concentration and their degree of fractionation because underground water develops a uranium isotope activity ratio that reflects the rock type and weathering conditions of the rocks that the water contacts. The Dolomite Series aquifer, which outcrops in many areas of the Transvaal, is a phreatic aquifer subdivided by vertical, impermeable dolomite dykes. Water samples were taken from eyes and wells in the far western Transvaal from Pretoria to the Grootfontein Eye. A minimum of 20 l was taken at each site due to the low concentration of uranium in the water. A large degree of isotopic fractionation was found throughout the aquifer. Results indicate that ion-exchange processes are abstracting elemental uranium as the water percolates downward. Water coming from the dolomite eyes represents a mixture of both shallow and deeply percolating elements. Age stratification in the study area was corroborated by previous study results using carbon-14 dating and tritium. (Seigler-IPA)
W81-04041

DISPERSION COEFFICIENT OF THE KOEBERG AQUIFER

B. R. Meyer.

Nuclear Active (Pretoria), No 22, p 15, 1980. 4 Fig.

Descriptors: *Dispersion coefficients, *Groundwater movement, *Aquifer characteristics, *Koebberg, South Africa, Iodine radioisotopes, *Radioactive tracers, Nuclear powerplants, Mathematical models, Aquifers, Model studies, Interfaces.

A radioisotope, ^{131}I , was used as a groundwater tracer to determine the dispersion coefficient and the velocity of groundwater flow for the Koebberg aquifer. These parameters were needed for a model to predict the movement of the freshwater/saltwater interface near the Koebberg power station foundations. The radioisotope was injected as a line source into one borehole and the breakthrough of the tracer was measured in a series of three more boreholes located down the slope of the water table. Water samples were taken regularly and analyzed at the Southern Universities Nuclear Institute at Faure. A breakthrough curve was de-

WET AND DRY REMOVAL OF TROPOSPHERIC FORMALDEHYDE AT A COASTAL SITE

Woods Hole Oceanographic Institution, MA.

A. M. Thompson.

Tellus, Vol 32, No 4, p 376-383, 1980. 1 Fig, 3 Tab, 25 Ref.

Descriptors: *Formaldehyde, *Air-water interfaces, Interfaces, Precipitation, *Seawater, Saline water, Brackish water, Organic carbon, Organic compounds, Deposition, Coastal waters, Gases, Troposphere.

Formaldehyde was investigated as an example of a photochemically reactive trace gas using measurements of its concentration in precipitation and surface seawater to estimate wet and dry air-sea transfer. The total flux was evaluated as a tropospheric removal mechanism and as a source of organic carbon to local waters. Studies were done at Woods Hole, Massachusetts, a mid-latitude coastal site. The study indicated that this pathway may represent a significant removal mechanism for tropospheric formaldehyde. The total flux of formaldehyde was calculated to be equivalent to an input of 4.8 micrograms/sq cm/year of organic carbon, which is greater than or equal to 1% of the estimated total organic carbon air-to-sea transfer. Since formaldehyde is not detected in the surface seawater samples, it is suggested that biological uptake might remove it. Studies indicate that seawater enriched with formaldehyde shows a gradual loss of the compound, whereas sterile water enriched with formaldehyde maintains the enriched level. (Baker-FRC)
W81-04231

2E. Streamflow and Runoff

ADAPTATION OF ILLUDAS FOR CONTINUOUS SIMULATION

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.

H. G. Wenzel, and M. L. Voorhees.

Journal of the Hydraulics Division, Proceedings of the American Society for Civil Engineers, Vol 106, No HY1, p 1795-1812, November, 1980. 5 Fig, 5 Tab, 6 Ref. OWRT-A-095-ILL(1).

Descriptors: *Soil moisture, *Storm runoff, *Hydrograph, Precipitation, Forecasting, Mathematical

Field 2—WATER CYCLE

Group 2F—Groundwater

veloped for each borehole. The Koeberg aquifer produced a series of breakthrough peaks rather than the expected. The multiple peaks appear to be caused by flow through different layers with the first set of peaks coming from the deepest layer. A model was developed to describe this flow through different layers. When fitted with experimental data, the model automatically determines the dispersion coefficient and velocities of groundwater in the separate layers and for the aquifer as a whole. (Seigler-IPA)
W81-04042

THE EFFECT OF INFILTRATION DISTRIBUTION ON ARTIFICIAL RECHARGE SCHEMES,

Thessaloniki Univ., Salonia (Greece). School of Technology.
For primary bibliographic entry see Field 4B.
W81-04072

MEASUREMENTS OF DISCHARGES FROM SOME OF THE MOUND SPRINGS IN THE DESERT OF NORTHERN SOUTH AUSTRALIA,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2D.
W81-04075

THERMAL AUREOLES OF IGNEOUS INTRUSIONS: SOME POSSIBLE INDICATIONS OF HYDROTHERMAL CONVECTIVE COOLING,
Brown Univ., Providence, RI. Dept. of Geological Science.
E. M. Parmentier, and A. Schedl.
Journal of Geology, Vol 89, No 1, p 1-22, January, 1981. 1 Tab, 9 Fig, 59 Ref.

Descriptors: *Hydrothermal studies, *Geologic formations, *Convection, *Thermodynamics, Igneous rocks, Physical properties, Temperature, Geology, Cooling, Mathematical models, Groundwater, Permeability, Viscosity, Thermal conductivity, Porosity, Oxygen, Groundwater movement.

The size and shape of thermal aureoles of igneous intrusions are examined as indicators of hydrothermal convective heat transport. Oxygen and hydrogen isotope studies provide evidence for the existence of meteoric hydrothermal circulation systems associated with shallow intrusions in permeable rock. The study began with mathematical modeling of the effects of groundwater circulation on maximum temperatures in rock surrounding an intrusion. Thermal aureoles of conductively cooled intrusions were reviewed, and a boundary layer model was developed for a case study of convective cooling on Cuillin gabbro, and the Lilloo intrusion. More detailed mapping would contribute to greater understanding of hydrothermal cooling. However, a general consistency between oxygen isotopic sampling and aureoles or other geologic data was demonstrated for the cases presented. (Titus-FRC)
W81-04229

2G. Water In Soils

SUBSURFACE DRAINAGE, AIR ENTRAPMENT AND INFILTRATION IN SAND,

Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
A. R. Jarrett, J. R. Hoover, and C. D. Paulson.
Transactions of the ASAE, Vol 23, No 6, p 1424-1427, 1433, November/December, 1980. 7 Fig, 14 Ref. OWRT-A-051-PA(2).

Descriptors: *Infiltration, *Air-earth interfaces, *Drainage, Erosion control, *Subsurface drains, Soil gases, Sand, Soil erosion, Surface runoff, Runoff, Rainfall, Soil physical properties.

The effects of entrapped soil air on infiltration of water in sandy soil were investigated in the laboratory under simulated rainfall conditions. The following conditions were used: free-flow (air in the drain was vented to atmospheric pressure), air-

trapped (air was trapped in the drain and simulated rainfall varied until the surface runoff rate equaled rainfall rate, at which point the entrapped air was vented), and submerged drain (drain outlet elevated 12 cm, causing a water table to develop in the sand above the drain). Free venting of the air via submerged drains increased infiltration and decreased surface runoff. In the other 2 cases drainage was delayed until soil air was released. (Cassar-FRC)
W81-03957

WATER REPELLENT SOILS: A STATE-OF-THE ART,

Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
L. F. DeBano.

Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, California, General Technical Report PSW-46, March, 1981. 22 p, 8 Fig, 170 Ref.

Descriptors: *Water repellent soils, *Forest fires, *Soil types, *Soil management, *Soil organic matter, Infiltration, Soil absorption capacity, Soil water, Erosion, Evaporation control, Water conservation, Runoff.

Normally, dry soils readily imbibe water; however some soils repel water. Water repellency, produced by soil heating, is common on burned watersheds in southern California. Water repellent soils are found throughout the world on both wildlands and on intensively cultivated lands. The severity of water repellency in soils is dependent on several factors. Organic matter and soil texture are the most important factors, although fire intensity and soil water are also important parameters affecting fire-induced water repellency. A host of organic substances of unknown composition seems involved in water repellency. The substances causing water repellency after fires are apparently aliphatic hydrocarbons formed from partly decomposed plant materials in the soil. Water movement can be severely limited by hydrophobic organic materials which are either intermixed with the soil or coat the mineral soil particles. Methods used to characterize water repellency include waterdrop penetration time, equilibrium liquid-solid contact angles, solid-air surface tension indices, and the characterization of dynamic wetting angles during infiltration. Infiltration, evaporation, soil-water potentials, and water transfer mechanisms are affected by water repellency. In some cases, water repellency is induced in order to conserve water, reduce nutrient loss, or improve soil structure, but water repellency may be undesirable and require some special management action to counteract its deleterious effects. (Moore-SRC)
W81-04016

ESTIMATION OF THE MOISTURE SUPPLY CAPACITY OF SOME SWELLING CLAY SOILS IN THE NETHERLANDS,

Soil Survey Inst., Wageningen (Netherlands). Dept. of Soil Physics.

J. Bouma, and P. J. M. De Laat.

Journal of Hydrology, Vol 49, No 3/4, p 247-259,

February, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Moisture availability, *Soil water, Soil types, *Clays, Hydrology, Model studies, Soil water table, Crops, Seasonal variation, Statistical analysis.

Clay soils were selected for study from four different locations in the riverine area along the Rhine River. The soils are classified as Typic Fluvaquents, very fine clayey, mixed, and mesic. The root zone is shallow and extends into the Big horizon to a depth of 20 cm below surface. Four field monitoring tensiometer cups were installed in duplicate in four pedons at depths of 2.5, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 cm below surface. Hydraulic conductivity of saturated soil was measured with the column method in very moist soil in the wet season in early spring. Climatic data were collected for the two types of simulation made during the study: simulation of real moisture conditions in the growing season for 1970 and simulation using generalized climatic conditions defined by

statistical procedures. Existing flow theory is not sufficient to describe the flow of water in swelling clay soils where desiccation is associated with the formation of both vertical and horizontal cracks in the soil. These cracks influence the flow regime by reducing upward fluxes to the root zone and by inducing rapid downward flow of water along vertical cracks. The field technique used allows an estimate to be made of the effective reduction of the hydraulic conductivity due to horizontal crack formation. The reduction was a function of the pressure head. Calculated moisture conditions in the soil agreed only with those that were measured in situ, when the effects of both horizontal and vertical cracking were considered. (Baker-FRC)
W81-04079

LYSIMETER FOR MEASURING ARID-ZONE EVAPOTRANSPIRATION,

New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 7B.

W81-04080

A SIMPLE ANALYTICAL SOLUTION FOR HORIZONTAL ABSORPTION OF WATER BY SOILS FOR EXPONENTIAL SOIL WATER DIFFUSIVITY,

Thessaloniki Univ., Salonia (Greece). School of Technology.

P. K. Tolikas, C. D. Tzimopoulos, and D. K. Tolikas.

Water Resources Research, Vol 16, No 4, p 821-825, August, 1980. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Unsaturated flow, *Soil water, Absorption, Wetting, Mathematical analysis, Diffusion coefficient.

A simple approximate analytical solution to the problem of horizontal absorption of water in unsaturated soils assumes exponential soil water diffusivity. Additional assumptions are that the medium is homogeneous and isotropic, the air pressure in the pores is equal to atmospheric, and the initial soil water content is constant. Presuming that the inflection point of the soil water content profile coincides with the wetting front, the infinite domain problem is reduced to a finite domain problem with one boundary at the inflection point. After calculating the soil water content at the inflection point and its location, an approximate solution to the problem can be obtained. Results of wetting front positions for different silts and loams are compared with results from three previous papers by other authors, with excellent agreement. (Cassar-FRC)
W81-04111

MODELING TRANSPORT OF REACTIVE SOLUTES DURING LEACHING SALINE - SODIC SOILS RICH IN SOLUBLE CARBONATES,

California Univ., Davis. Dept. of Land, Air and Water Resources.

For primary bibliographic entry see Field 2K.

W81-04140

NITRATE MOVEMENT WITH ZERO-ORDER DENITRIFICATION IN A SOIL PROFILE,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.

R. S. Kanwar, J. L. Baker, H. P. Johnson, and D. Kirkham.

Soil Science Society of America Journal, Vol. 44, No. 5, p 898-902, September/October, 1980, 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Denitrification, *Soil solution, *Nitrates, Mathematical models, Soil chemistry, Soil water, Ion transport, Ion exchange.

A theoretical analysis is presented of the movement of nitrates in an unsaturated soil with zero-order denitrification. The diffusion coefficient and the rate coefficient for denitrification were assumed to be independent of ionic concentration. The concentration and velocity of the solution in soil were taken as average of many discrete values. These assumptions do not necessarily reflect the

Lakes—Group 2H

real situation, but are used to predict the NO_3^- distribution in the soil as a function of time and depth. This distribution is influenced by moisture content, diffusivity, pore solute velocity, cation exchange capacity of soil, and rate constant for denitrification. Over time, most of the NO_3^- N can move into the lower soil layers and is wasted unless it is taken up by roots. A physical plant growth model could be combined with this type of mathematical solution for movement and transformation of NO_3^- N to improve the efficiency of nitrogen use by crops. The results of the model developed here were compared with experimental data. The rate of denitrification was a function of all parameters found in the laboratory. (Small-FRC)
W81-04250

2H. Lakes

A. REINTERPRETATION OF THE 1857 SURFACE ELEVATION OF MONO LAKE

California Univ., Berkeley. Dept. of Geography. S. Stine. California Water Resources Center, University of California, Davis, Report No 52, April, 1981. 41 p, 14 Fig, 3 Append.

Descriptors: *California, *Lakes, *Lake basins, *Diversion losses, *Geological surveys, Meanders, Saline lakes, Lake evaporation, Precipitation rate, Lake shores, Tributaries, Streams, Topographic mapping, Water level fluctuations, *Mono Lake.

Survey notes and plans of the first meander study of Mono Lake in 1930s were used as the basis of investigations in the 1930s and 1940s to estimate the 1857 lake surface level. This report re-examines the cartographic evidence and concludes that the level was more than 30 feet higher than that proposed in earlier investigations. In addition, (1) in 1857 the lake contained approximately 60 percent more water and correspondingly was only about 60 percent as saline as had been supposed; (2) in places the 1857 lake shoreline was over 7,500 feet upslope from the position implied in much of the current literature; and (3) the surface elevation of Mono Lake during the past four decades has fallen approximately 40 feet due to water diversions by the City of Los Angeles; however, prior to these diversions the lake surface had not been substantially below 6,400 feet for about 900 years. Although it has been assumed that many of the controversial environmental changes that are being induced by the artificial lowering of the lake have occurred in the past during times of naturally low lake levels, the findings of this study contradict that view. Some of the climatological and ecological implications of the new findings are discussed briefly. (Garrison-Omniplan)
W81-04029

SURFACE AND COMPLEXATION EFFECTS ON THE RATE OF Mn^{2+} OXIDATION IN NATURAL WATERS

Kinnetic Labs, Inc., Anchorage, AK. For primary bibliographic entry see Field 2K.
W81-04067

CHRONOLOGICAL VARIATIONS IN CONCENTRATIONS AND ISOTOPIC COMPOSITIONS OF ANTHROPOGENIC ATMOSPHERIC LEAD IN SEDIMENTS OF A REMOTE SUB-ALPINE POND

California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences. H. Shirahata, R. W. Elias, and C. C. Patterson. Geochimica et Cosmochimica Acta, Vol 44, No 2, p 149-162, 1980. 7 Fig, 5 Tab, 41 Ref.

Descriptors: *Lead, *Alpine regions, Cold regions, Mountains, *Ponds, *Sediments, Air pollution, Industrial wastes, Precipitation.

This report documents, in a manner analogous to the study of lead in Arctic snow strata, large increases in the concentrations of industrial lead in remote open-country atmospheres that have occurred since 1850. The study is based on the chron-

ological record of precipitation and dry deposition inputs of lead deposited in pond sediments in a remote non-domesticated subalpine ecosystem which represents extensive uncultivated non-urban areas of North America. In the mountain pond studied, lead concentrations decreased 4-fold in going from the surface of sediments to layers 130 yr old. A corresponding change was noted in the $\text{Pb-206}/\text{Pb-207}$ ratio in the sediments, from industrial-like values of 1.18 near the surface to natural values of 1.24 at depth. Calcium, strontium and barium concentrations remained relatively constant with depth. The excess lead appeared to be of eolian anthropogenic origin. These findings prove that inputs of contaminating lead were nearly absent centuries ago in this location, but are present today in the ecosystem in amounts more than 20 times the natural inputs. As a consequence of these inputs the lead concentrations in plants have been elevated 5-fold and in animals 50-fold beyond natural levels. Atmospheric concentrations of about 10 ng of lead/cubic meter are responsible for this increased contamination. (Baker-FRC)
W81-04068

POLYCYCLIC AROMATIC HYDROCARBONS IN RECENT LAKE SEDIMENTS - I. COMPOUNDS HAVING ANTHROPOGENIC ORIGINS

Woods Hole Oceanographic Institution, MA. Dept. of Chemistry. S. G. Wakeham, C. Schaffner, and W. Giger. Geochimica et Cosmochimica Acta, Vol 44, No 3, p 403-413m 1980. 6 Fig, 2 Tab, 49 Ref.

Descriptors: *Hydrocarbons, *Lake sediments, Sediments, Lakes, *Switzerland, *Washington, Sedimentation, Industrial wastes, Urban runoff.

The occurrence of anthropogenically generated polycyclic aromatic hydrocarbons (PAH) was examined in four lakes: Lake Lucerne, Lake Zurich, and Lake Greifensee, in Switzerland, and Lake Washington in the northwestern section of the United States. A rich collection of PAH was found in the recent sediment samples from these lakes. Major components are unsubstituted species. However, many alkylated derivatives were also found at lower concentrations. Similar qualitative patterns of PAH were noted in the surface sediment layers from each lake, regardless of the location or level of anthropogenic activity in its catchment basin. Surface sediments were enriched to higher degrees than deeper layers, where few PAH could be detected. Urban runoff containing street dust particles was listed as a possible major present-day source for the PAH in the lakes studied. This street dust is washed from roads during heavy rain storms and transported by rivers and streams, to eventually accumulate in lake sediments. Asphalt particles in the street dusts may be an extremely important contributor to the PAH content of lake sediments. (Baker-FRC)
W81-04102

POLYCYCLIC AROMATIC HYDROCARBONS IN RECENT LAKE SEDIMENTS - II. COMPOUNDS DERIVED FROM BIOGENIC PRECURSORS DURING EARLY DIAGENESIS

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland). S. G. Wakeham, C. Schaffner, and W. Giger. Geochimica et Cosmochimica Acta, Vol 44, No 3, p 415-429, 1980. 11 Fig, 2 Tab, 61 Ref.

Descriptors: *Hydrocarbons, *Lake sediments, Sediments, Lakes, *Switzerland, *Washington, Diagenesis, Sedimentation.

The naturally occurring recent aquatic sediments of polycyclic aromatic hydrocarbons (PAH) were examined in four lakes: Lake Lucerne, Lake Zurich, and Lake Greifensee, in Switzerland, and Lake Washington in the northwestern section of the United States. In these lakes perylene concentrations generally increased with increasing depth in the sedimentary column, making perylene the most abundant aromatic hydrocarbon in the deeper and older sediment layers. Perylene concentrations as a function of depth are structured and vary

between the four lakes. Phenanthrene and an extended series of alkylated homologs were present at all depths in all sediment cores. Evidence points to a diagenetic origin for the phenanthrenes. An untested suggestion is that microorganisms control the alkylphenanthrene isomer distributions in both contaminated and uncontaminated sediments. Retene and pimanthrene were present in Lake Washington sediments at high concentrations, but were essentially absent from the other lakes. The hypothesis that retene in sedimentary materials is derived from abietic acid, a common diterpenoid acid in conifer resin and other higher plant lipids, is supported by Lake Washington data. (Baker-FRC)
W81-04103

NITROGEN FIXATION BY THE PHOTOSYNTHETIC SULFUR BACTERIUM CHLOROBIUM PHAEOBACTEROIDES FROM LAKE KINNERET

Kinneret Limnological Lab., Tiberias (Israel). T. Bergstein, Y. Henis, and B. Z. Cavari. Applied and Environmental Microbiology, Vol 41, No 2, p 542-544, February, 1981. 4 Fig, 22 Ref.

Descriptors: *Sulfur bacteria, *Lake Kinneret, *Nitrogen fixation, Israel, Bacteria, Photosynthetic bacteria, Nitrogen compounds, Ammonium compounds, Aquatic life, Microorganisms, Phytoplankton.

Ammonia concentrations up to 5 mg N per liter did not inhibit but actually stimulated nitrogen fixation in cultures of the green sulfur bacterium, Chlorobium phaeobacteroides, isolated from Lake Kinneret. Nitrogen fixation was inhibited by ammonia concentrations higher than 5 mg N per liter. The ammonia concentration in the Lake Kinneret thermocline ranges from 0.3 to 0.5 mg N per liter. Increased light raised nitrogen fixation activity. Photosynthetic activity was maximum at a depth of 3 meters and decreased to 0 at the thermocline (20 meters). There is probably no contribution to the organic nitrogen load in Lake Kinneret by the C. phaeobacteroides bloom. (CASSAR-FRC)
W81-04104

MEASUREMENT OF PLANKTONIC BACTERIAL PRODUCTION IN AN OLIGOTROPHIC LAKE

Marine Biological Lab., Woods Hole, MA. Ecological Systems Center. For primary bibliographic entry see Field 5A.
W81-04129

THE ROLE OF METHANE IN INTERNAL CARBON CYCLING IN LAKE MENDOTA DURING SUMMER STRATIFICATION

Wisconsin Univ.-Madison. Dept. of Bacteriology. R. D. Fallon, S. Harris, R. S. Hanson, and T. D. Brock. Limnology and Oceanography, Vol 25, No 2, p 357-360, March, 1980. 1 Tab, 14 Ref.

Descriptors: *Methane, *Oxidation, *Caron cycle, *Stratification, *Lake Mendota, Wisconsin, Nutrients, Eutrophication, Hypolimnia, Sedimentation, Organic carbon.

Methane production and oxidation were related to the overall carbon balance of Lake Mendota, Wisconsin. During the stratified period methane distribution peaked between 16 and 24 meters depth. Most of the methane oxidation took place over a broad range of 4 to 6 meters vertical extent. Total methane production for the 3-month period was estimated at 2,210 nmol C per sq meter; methane oxidized was 999.5 nmol C per sq meter (45% of total); methane lost to the atmosphere was 181.7 nmol C per sq meter (8% of total); and hypolimnetic methane accumulation was 1,028.8 nmol C per sq meter (47% of total). An estimated 35.8 nmol C per sq meter per day of methane was produced by deep sediments; about 54% of the total particulate organic carbon sedimented returned as methane. Much more methane was oxidized in Lake Mendota (47%) than in Lake 227, Canada (11%). Possible reasons for this difference are dissimilarities in physical characteristics. Lake Mendota has 3 times

Field 2—WATER CYCLE

Group 2H—Lakes

the production, 780 times the surface area, greater wind turbulence, and less stability in the water column than Lake 227. Oxidation of methane probably continues during winter under the ice in Lake Mendota, where the water column is oxygenated to within 1-2 meters of the bottom and nutrients are available. (Cassar-FRC)
W81-04149

THE INFLUENCE OF THE CONTAMINATION OF LA ALBUFERA DE VALENCIA ON THE POPULATION OF DIATOMS IN THE LAKE. (LA INFLUENCIA DE LA CONTAMINACION DE LA ALBUFERA DE VALENCIA EN LA POBLACION DE DIATOMAS DEL LAGO),
Valencia Univ., Politecnica(Spain).

J. G. del Rio Rami, and L. A. Hartohner Fernandez.

Progress in Water Technology, Vol 12, No 4, p 473-479, 1980. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Eutrophication, *Salinity, *Heavy metals, *Lakes, *Spain, La Albufera, Water pollution sources, Population dynamics, Algae, Diatoms.

The degenerative process of Lake Albufera, 12 km from Valencia, connected to the Mediterranean Sea by three channels and contaminated by many irrigation canals, was analyzed by a series of chemical and biological analyses of samples taken in 1975 from 23 shore points and 7 points inside the lake. The progressive salinization of the lake and its chloride content were studied, in particular. The chloride cycle was due to a marine intrusion and to variations in the rainfall in the zone. The presence of other types of contaminants, particularly heavy metals, and the eutrophication were studied to determine the effects on the diatom flora, especially on the populations of *Syndra* sp., *Nitzschia* palea, *Cyclotella* atomus, *Cyclotella* maneghiniana and *Melosira* varians. In the case of diatoms the degenerative process led to differences of the populations from those of other humid zones of the non-contaminated coast, as well as large differences from those of the irrigation canals flowing into the lake (due principally to the progressive salinization of the lake). In the year from 11/74 to 12/75 there was a considerable variation in the population. *Melosira* varians showed a clear inability to adapt to the presence of chlorides. The variation in *Nitzschia* kutziniana is due to the fact that this is a heterotrophic species, requiring nitrogen. (Hertzoff-FRC)
W81-04201

SOME FACTORS AFFECTING THE DISTRIBUTION AND ABUNDANCE OF THE TWO MELANIAN SNAILS, SEMISULCOSPIRA DECIPiens AND S. RETICULATA, IN LAKE BIWA,
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).

N. C. Watanabe.

Japanese Journal of Limnology, Vol 41, No 4, p 212-224, October, 1980. 13 Fig, 1 Tab, 15 Ref.

Descriptors: *Snails, *Particle size, *Bottom sediments, Distribution patterns, Aquatic habitats, Lakes, Aquatic animals, Invertebrates, *Lake Biwa, Japan, Benthic fauna, Growth stages, Habitats, Seasonal.

Semisulcospira decipiens and *Semisulcospira reticulata*, endemic in Lake Biwa, Japan, occupied different area but overlapped somewhat in distribution. *S. decipiens* was found on shallow bottoms less than 3 meters. Density was inversely related to water depth. No correlation between density of snails and grain size of the substratum was observed. *S. reticulata* was generally found on bottoms deeper than 3 meters and on shallower muddy bottoms. Grain size was not important within the muddy range. Neither species changed habitat with season or developmental stage. (Cassar-FRC)
W81-04280

DYNAMIC ASPECTS OF DINOFLAGELLATE DISTRIBUTION PATTERNS IN A SMALL PRODUCTIVE LAKE,

Freshwater Biological Association, Ambleside(England).
S. I. Heaney, and J. F. Talling.
Journal of Ecology, Vol 68, No 1, p 75-94, March, 1980. 9 Fig, 1 Tab, 36 Ref.

Descriptors: *Dinoflagellates, *Distribution patterns, *Winds, Algae, Aquatic algae, Ceratium hirundinella, Phytoplankton, *Lakes, Photosynthesis, Hypolimnion, Epilimnion, Euphotic zone.

The vertical and temporal distribution patterns of the dinoflagellate *Ceratium hirundinella* O.F. Muller were studied by sampling at one location in Esthwaite Water, a small English lake, during 1966-67 and 1975-77. In the euphotic zone, near-exponential increase occurred in March-July, a stationary but fluctuating density in July-September, and a rapid decline with encystment in late September-early October. *Ceratium* were found in the epilimnion but not in the anoxic hypolimnion. Vertical distribution during the exponential growth period was affected by the underwater light climate and the thermocline under low wind stress conditions. Cells avoided the surface and reached a maximum population at 3-4 meters depth, where 10% of the surface-penetrating irradiance was measured. During the stationary phase, cells aggregated near the surface during daytime. Light wind (3 meters per second) along the long axis of the lake induced a concentration of algae at the windward end from upwelling of subsurface algae and transport of algae in surface water. Stronger winds caused turbulent mixing and eliminated vertical stratification. (Cassar-FRC)
W81-04292

2. Water In Plants

THEY'RE WORKING TO SAVE YOUR LIFE, BLOOD,
For primary bibliographic entry see Field 3F.
W81-04046

THE EFFECT OF WATER STRESS ON THE NITROGEN METABOLISM OF TWO MAIZE LINS: 1. EFFECTS ON THE PROTEIN CONTENT AND RNASE ACTIVITY,
Potchefstroom Univ. for C. H. E. (South Africa).
Dept. of Botany.
R. C. Botha, and P. J. Botha.
Journal of South African Botany, Vol 46, No 1, p 45-52, 1980. 4 Fig, 15 Ref.

Descriptors: *Corn, *Drought resistance, *Water stress, *Plant physiology, *Proteins, Plant growth, Nitrogen compounds, Plant tissues, Leaves, Plant water potential, RNase activity, Turgidity, Drought, Water requirements.

An experiment on the drought resistance of two maize lines, AS81 and G556DT, shows that estimation of protein content may be an effective method for the selection of drought resistant plants. The maize was grown in a controlled environment with a day length of 13 h, a temperature of 29°C, a relative humidity of 35%, and a light intensity of 14,440 lux. After five weeks only the control plants were watered and experimental samples were taken on the first, third, fifth, and seventh day after the experimental plants were last watered. The relative water deficit (RWD) was estimated and the water soluble proteins were extracted. RNase activity was also determined. Both maize lines showed a linear increase in RWD with increasing water stress, however, the RWD of A821 was higher through the entire stress period, especially from the third day on. While G556DT had a higher estimated water soluble protein content, the protein content of both lines decreased rapidly with increased water stress. The protein content of G556DT decreased at a lower rate. RNase activity increased rapidly in A821 while G556DT only showed an increase after the third day. G556DT's higher drought resistance is possible due to a higher protein content caused by the lower RNase activity and possibly by a more stable protein structure. (Seigler-IPA)
W81-04247

Two grasses, *Deschampsia cespitosa* and *Dactylis glomerata*, were compared under different soil moisture regimes in glasshouse pot experiments. Soil water deficits greater than 10 mm between waterings reduced germination and early seedling growth in both species. Well-established 8 week old seedlings tolerated a 200 mm soil water deficit without a decrease in dry weight. However, a high water table favored germination and growth of *Deschampsia*. Dry matter production at high water tables was about equal for both species, but *Dactylis* produced twice as much dry matter as *Deschampsia* at other soil moisture regimes. Current field studies in which both grasses were grown in competition with one another in dry, moist, and wet sites showed that *Dactylis* was always more productive than *Deschampsia*, both growing best in moist sites. *Deschampsia* was most successful in competition in wet sites and was severely depressed by competition in dry sites. (Cassar-FRC)
W81-04247

EXPLOITATION OF FOG WATER BY A PERENNIAL NAMIB DUNE GRASS, STIPAGROTIS SABULICOLA,
Cape Town Univ. (South Africa). Dept. of Zoology.

G. N. Louw, and M. K. Seeley.

South African Journal of Science, Vol 76, No 1, p 38-39, January, 1980. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Stripagrotis sabulicola, *Namib Desert, *Fog, *Grasses, *Roots, Root distribution, Drought resistance, Plant morphology, Soil water, Radioactive tracers, Arid lands, Precipitation, Leaves, Plant tissues, Plant populations, Plant growth.

A study of two large specimens of *Stipagrotis sabulicola* in the Namib Desert shows that the plant's extensively developed lateral root system enables it to survive for many years with little or no rain by absorbing condensed fog water. *S. sabulicola* has leaves that are tightly rolled into spikes and a poorly developed vertical root system. It has laterally running adventitious roots that can extend as far as 20 m from the main plant. Root depth beneath the surface of the sand varies mostly between 1 to 10 cm. Wind action on the unstable substrate of the desert exposes some of the roots to the atmosphere. Two large plants were exposed to simulated fog conditions using tritiated water. Plant material samples were taken and analyzed after 26 hours and after 7 weeks. Results show that labelled water was absorbed by the lateral roots of both plants. The water was present in the main vertical roots and leaves after 26 hours. After seven weeks there was little radioactivity in the green leaves and stems, while the main vertical roots and lateral roots contained large amounts of the tritiated material. *S. sabulicola* apparently makes very efficient use of water and is able to survive on the occasional exploitation of precipitated fog water. (Seigler-IPA)
W81-04050

A COMPARISON OF THE ECOLOGY OF DESCHAMPSIA CESPITOSA AND DACTYLIS GLomerata IN RELATION TO THE WATER FACTOR II. CONTROLLED EXPERIMENTS IN GLASSHOUSE CONDITIONS,
Imperial Coll. of Science and Technology, London (England). Dept. of Botany.
M. S. Raman, and A. J. Rutter.
Journal of Ecology Vol. 68, No. 2, p 479-491, July, 1980. 3 Fig, 6 Tab, 5 Ref.

Descriptors: *Grasses, *Soil moisture, *Soil-water-plant relationships, Water table, Consumptive use, Plant growth, Ecology, Germination.

Two grasses, *Deschampsia cespitosa* and *Dactylis glomerata*, were compared under different soil moisture regimes in glasshouse pot experiments. Soil water deficits greater than 10 mm between waterings reduced germination and early seedling growth in both species. Well-established 8 week old seedlings tolerated a 200 mm soil water deficit without a decrease in dry weight. However, a high water table favored germination and growth of *Deschampsia*. Dry matter production at high water tables was about equal for both species, but *Dactylis* produced twice as much dry matter as *Deschampsia* at other soil moisture regimes. Current field studies in which both grasses were grown in competition with one another in dry, moist, and wet sites showed that *Dactylis* was always more productive than *Deschampsia*, both growing best in moist sites. *Deschampsia* was most successful in competition in wet sites and was severely depressed by competition in dry sites. (Cassar-FRC)
W81-04247

2J. Erosion and Sedimentation

BIOTIC IMPACT OF ORGANIC AND INORGANIC SEDIMENTS,
Environmental Protection Agency, Chicago, IL. Region V.

J. K. Bland.

Available from the National Technical Information

Chemical Processes—Group 2K

Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: *Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution*, September 16-17, 1980, Chicago, Illinois. EPA Report EPA-905-9-80-009, September, 1980. p 365-375, 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Suspended sediments, *Bottom sediments, *Organic matter, *Particulate matter, *Stream biota, Decomposing organic matter, Plankton, Environmental effects, Sand, Clays, Water quality, Turbidity.

Restoring the chemical, physical, and biological integrity of the nation's waters requires knowledge of the structural and functional characteristics of natural aquatic ecosystems and the adoption of a systematic set of biologically based goals. In studies of the biotic effects of sediments, two broad classes of sediments can be distinguished, organic and inorganic. In first, second, and third order reaches of streams, energy input into the system derives from stream-side vegetation. Coarse Particulate Organic Matter (COPM) is broken down and fragmented into Fine Particulate Organic Matter (FPOM) which is subsequently transported downstream. The mid-reaches of the stream continuum (fourth through sixth order streams) is the major region of primary productivity, and FPOM is the dominant variety of import material. Further downstream (seventh to twelfth order) the stream energy economy again shifts and becomes heterotrophic, with more turbidity and an increased importance for plankton. The increased turbidity reduced light penetration, the potential for photosynthesis is reduced, and substrate availability for periphyton is reduced. Inorganic sediments are generally assigned on the basis of size and physical method of transport to suspended load or bed load. Suspended loads typically are silts and clays supplied by the watershed. Bed load is composed of larger particles including sand and gravel which are not typically a part of the water column. Biotic impacts of bed load movement are generally attributable to abrasion, scour, and burial. Suspended load increases turbidity, and may interfere with photosynthesis and respiration. (Moore-SRC) W81-03985

SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,
Department of Water Affairs, Pretoria (South Africa).

T. P. Van Robbroeck.
The Civil Engineer in South Africa (Johannesburg) Vol 22, No 2, p 34-36, February, 1980. 5 Fig, 1 Tab.

Descriptors: *Reservoir silting, *Sedimentation rates, *Lake sediments, *Bottom sediments, *Sediment distribution, Surveys, Surveying instruments, Reservoir storage, Reservoir capacity, Mapping, *South Africa, Data processing, Echo sounding, Silting.

Sediment surveys of 24 dams in South Africa were conducted using a sophisticated, automated measuring and calculating method. For a survey, the original dam basin is divided into compartments bounded by accurately measured cross sections marked by permanent silt beacons. Each compartment is then treated as a separate unit and capacity tables and constant factors are derived for each compartment. This part of the survey is only done once and does not have to be repeated for future surveys. The volume of silt deposited is determined by resurveying only the end areas of the compartments. Aerial surveying is done electronically using echoes from an echo sounder in a boat. An electro-magnetic range measuring device, ralog, measures the distance to the shore. A surveyor observing the boat's mast through a theodolite keeps the boat on course by radio signals. All survey data are initially recorded on charts. These data are then digitized and fed to a computer for calculating and plotting. This method is quick and efficient and will allow for more frequent surveying of dams with heavy silt deposits. The Tennessee Valley Authority and the US Bureau of Reclamation are using this improved method. (Seigler-IPA)

W81-04055

SEDIMENT TRANSPORT AND A RESERVOIR SILTATION FORMULA FOR ZIMBABWE-RHODESIA,

Rhodesia Univ., Salisbury. Dept. of Civil Engineering.

P. R. B. Ward.

Civil Engineer in South Africa (Johannesburg), Vol 20, No 1, p 9-15, January, 1980. 12 Fig, 5 Tab, 21 Ref.

Descriptors: *Zimbabwe-Rhodesia, *Sediment transport, *Reservoir silting, *Sedimentation, Suspended load, Colorimetry, Turbidity, Water sampling, Catchment areas, Soil erosion, Rainfall-runoff relationships, Bed load, Suspended solids, Trap efficiency, Africa.

A reservoir siltation formula for low trap efficiency, small reservoirs was developed using data from field measurements of the suspended sediment load of rivers draining five large catchments in Zimbabwe-Rhodesia. All catchments sampled were 1,500 sq km or larger. Two of the catchments had reservoirs that were important municipal supply sources. Measurements were taken on every significant flow event over a period of three years. Samples were taken automatically at one site while all other samples were taken manually in wide-mouthed 600 ml bottles. Suspended sediment concentrations were measured using a Corning Colorimeter, Model 252. Dissolved load measurements were made with a Hydroproducts Model TC-2 Conductivity/Temperature Meter. Bed load transports and size distribution determinations were also made. Mean distribution curve characteristics were developed for each river. Analysis of the laboratory results produced an order of magnitude amount of 40/l/sq km/year as an upper bracket sediment transport value for design purposes. From the results a reservoir siltation formula was developed for the low trap efficiencies of small reservoirs. (Seigler-IPA)

W81-04057

GEOCHEMISTRY OF MOLYBDENUM IN SOME STREAM SEDIMENTS AND WATERS,
Colorado Univ. at Boulder. Dept. of Geological Sciences.

For primary bibliographic entry see Field 5B.
W81-04065

SOURCES, DISPERSAL, AND CLAY MINERAL COMPOSITION OF FINE-GRAINED SEDIMENT OFF CENTRAL AND NORTHERN CALIFORNIA,

California Univ., Santa Cruz.

G. B. Griggs, and J. R. Hein.
Journal of Geology, Vol 88, No 5, p 541-566, September, 1980. 14 Fig, 3 Tab, 53 Ref.

Descriptors: *Marine sediments, *Suspended sediments, *Sediment transport, Sedimentology, Sediment yield, River systems, Sediment concentration, California, Water currents.

The sources of fine-grained sediment on the continental shelf and upper slope off California from Point Conception to the Oregon border were determined. Also, the volumes contributed by each source and the patterns and mechanisms of offshore dispersal of terrigenous sediment were determined. Eighty-one percent of the sediment was suspended sediment from the Eel, Klamath-Trinity, Mad, Smith, and Mattole Rivers and Redwood Creek. Average annual sediment yields of up to 2800 tons/sq km were produced by a combination of steep and unstable hillslopes and high rainfall. LANDSAT instrumentation revealed that large clockwise gyres transport sediment at least 100 km offshore in surface waters. Lower precipitation and numerous impoundments reduced the amount of sediment discarded along the central coast. From Monterey Bay to Point Conception, where the climate is quite dry, sediment loads were even less. (Small-FRC)

W81-04182

2K. Chemical Processes

SURFACE AND COMPLEXATION EFFECTS ON THE RATE OF Manganese(II) OXIDATION IN NATURAL WATERS,
Kinnetic Labs., Inc., Anchorage, AK.

D. E. Wilson.

Geochimica et Cosmochimica Acta, Vol 44, No 9, p 1311-1317, 1980. 6 Fig, 10 Ref.

Descriptors: *Manganese, *Oxidation, Natural waters, Lakes, Limnology, Surface waters, Reservoirs, Particulates.

The influence of montmorillonite, kaolinite, goethite, and particulate and soluble natural organic materials on the rate of Mn(II) oxidation was investigated. Surfaces accelerate reaction, apparently by bonding Mn(2+) in a manner which fulfills the requirements of the transition state. Soluble organic materials retard the reaction by complexing the oxidizable species. Whether particulate matter influences the oxidation process under natural loading conditions is doubtful. To produce measurable changes in the reaction rate 50-500 mg/liter quantities are required. Complexation by humic materials, however, might be expected to reduce the rate of oxidation by an amount proportional to the dissolved organic carbon concentration. Oxidation followed by precipitation is predicted to be an important mechanism for Mn(2+) removal in oceanic waters. The same situation in lake waters is more difficult to predict. (Baker-FRC)

W81-04067

GEOCHEMISTRY OF HYDROTHERMAL ALTERATION AT THE ROOSEVELT HOT SPRINGS THERMAL AREA, UTAH,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.

W. T. Parry, J. M. Ballantyne, N. L. Bryant, and R. E. Dedolph.

Geochimica et Cosmochimica Acta, Vol 44, No 1, p 95-102, 1980. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Hot springs, *Hydrothermal studies, *Geochemistry, Water analysis, Springs, Minerals, Chemical reactions, Saline water, Geologic fractures, Utah.

The Roosevelt thermal area, under evaluation as a commercial power source, contains a dilute brine at a surface temperature of 25°C (down from 85°C in 1950) with ionic strength of 0.1-0.2 and total dissolved solids of 6063-7792 mg per liter. Other constituents (mg per liter) are as follows: Na, 1840-2500; Ca, 22-122; K, 274-48; SiO₂, 173-639; mg, 1025; Cl, 3120-4240; sulfate, 48-120; bicarbonate, 25-298. The spring water contains 10 times the Ca, 100 times the Mg, and 2.5 times the sulfate of the deeper water. A model for development of the observed alterations is supported by observation and irreversible mass transfer calculations. Hydrothermal fluid rises along major fractures; cooling occurs by conduction and steam separation. pH rises from loss of carbon dioxide. Oxidation of H₂S takes place at the surface to form hydrogen and sulfate ions. This acid water percolates downward and reacts with feldspar in the rocks to produce alunite, kaolinite, montmorillonite, and muscovite within 30 meters of the surface. Surface deposits consist of opaline sinter and sinter-cemented alluvium, altered by the sulfate-rich water to alunite and opal. (Cassar-FRC)

W81-04137

MODELING TRANSPORT OF REACTIVE SOLUTES DURING LEACHING SALINE - SODIC SOILS RICH IN SOLUBLE CARBONATES,
California Univ., Davis. Dept. of Land, Air and Water Resources.

I. S. Dahiyia, I. P. Abrol, and S. Hajrasuliha. Agricultural Water Management, Vol 3, No 1, p 3-16, 1980. 4 Fig, 4 Tab, 36 Ref.

Descriptors: *Solute transport, *Mathematical models, *Leaching, Soil solution, Leachates, Saline soils, Carbonates, Calcium, Soil science.

Field 2—WATER CYCLE

Group 2K—Chemical Processes

A simple multicompartiment model was developed on the basis of discontinuous flow to describe the distribution of reactive solutes in adsorbed, solution, and precipitated phases following leaching of a relatively dry saline-sodic soil rich in soluble carbonates with calcium-containing water. The model was tested using data from leaching experiments in soil columns using saline-sodic soil from the experimental farm of the Central Soil Salinity Research Institute, Karnal, India. Agreement was good between experimental data and model results for profiles of soluble carbonates, exchangeable calcium, and soluble calcium. In most cases, the average concentration profiles were essentially the same for experimental and calculated results. The model was found to be sufficiently good and safe for the screening of treatment and general predictive purposes even though based on simple assumptions. (Small-FRC) W81-04140

2L. Estuaries

WILLAPA BAY: A HISTORICAL PERSPECTIVE AND A RATIONALE FOR RESEARCH, J. W. Hedgepeth, and S. Obrebski.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-21272, Price codes: A04 in paper copy, A01 in microfiche. Fish and Wildlife Service, Biological Services Program, Report FWS/OBS-81/03, April, 1981. 60 p, 18 Fig, 61 Ref.

Descriptors: *Estuarine environment, *Oysters, *Tidal effects, *Productivity, *Bays, Shellfish farming, Runoff, Tidal prism, Wetlands, Water exchange. Research priorities, *Willapa Bay (Washington).

Willapa Bay is a complex estuary nourished by several medium-sized rivers draining from a basin of about 1,865 sq km in southwestern Washington. The bay encompasses about 260 sq km at mean high water, and more than 50% of the total high tide surface area is exposed at low tide. The entrance to Willapa Bay is about 45 km north of the mouth of the Columbia River, near enough so that the waters of the bay can be modified by Columbia River effluent during the winter months. Mean annual runoff for the entire basin is estimated to be 3,400,000 acre-ft/yr. Even though the tidal prism is large, there is not always a fast turnover of bay water. Conditions in the ocean determine how much of the water exiting the bay will return on the next incoming tide. Willapa Bay is fringed by extensive wetlands, including mud flats and salt marshes. It is perhaps the most productive bay on the Pacific coast. It is optimum environment for many estuarine organisms, particularly the oyster. This productivity is enhanced by the relative freedom from industrial pollution, the water exchange with the sea, and good circulation within the bay. Over 50% of the oyster production in Washington is from Willapa Bay. One of the side effects of the introduction of oysters to supplement or replace less desirable native species has been the introduction of exotic invertebrates and plants. Research issues and questions which should be studied include: the importance of eelgrass; the influence of runoff on productivity; the effects of dredging and filling; why some areas are favorable for the growth of oysters while others are favorable for fattening them; the significance of microorganisms; and the relationship between seasonal succession and climatic variation. (Moore-SRC) W81-04017

DIFFERENCES BETWEEN SOUTH ATLANTIC AND GULF COAST MARSHES, Mississippi State Univ., Mississippi State. Dept. of Biological Sciences. For primary bibliographic entry see Field 2A. W81-04021

THE RELATIONSHIP OF ESTUARINE PRODUCTIVITY TO WOODED SWAMPS AND BOTTOMLAND FORESTS IN THE SOUTHEASTERN U.S. Louisiana State Univ., Baton Rouge. Coastal Ecol-

ogy Lab.

J. W. Day, Jr., W. H. Connor, G. P. Kemp, and D. G. Chambers.

In: Proceedings, U.S. Fish and Wildlife Service Workshop on Coastal Ecosystems of the Southeastern United States, Big Pine Key, Florida, 18-22 February 1980. Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/79, February, 1981. p 193-213. 7 Fig, 2 Tab, 31 Ref.

Descriptors: *Estuarine environment, *Primary productivity, *Bottomland, *Hydrology, *Swamps, Forests, *Environmental management, Flow, Water exchange, Salinity, Wetlands, Nutrients, Ecosystems, Flooding, Land management, Comparison studies, Southeastern U.S.

Swamps and bottomland forests are very productive ecosystems. Many extensive tracts are located in close proximity to estuaries and may be important in the functioning and productivity of an estuary. Net primary productivity values range from 200 g dry wt/sq m/yr for impounded areas to 1500 g dry wt/sq m/yr for seasonally flooded areas. Nutrient chemistry in swamp water and sediments is strongly affected by oxygen levels which are a function of water exchange. Swamps and bottomland forests are coupled to estuarine processes in a number of ways. They may serve as nursery habitat for marine species. Water, nutrient, and organic export from these areas may be considerable and affect the salinity balance and productivity of estuaries. Human activities have affected swamps and bottomland forests in many ways. Large areas have been drained and cleared for agricultural and urban development. Impoundments have lowered swamp and bottomland forests' productivity. Canals and channelization have led to more erratic hydroperiods and have affected water quality and caused land-loss problems. Management should consider the key role of hydrology in functioning of estuaries, swamps, and bottomland forests. The drainage basin is the most appropriate level of management. (Author's abstract) W81-04024

REDUCED FRESHWATER INFLOW IMPACTS ON ESTUARIES,

Fish and Wildlife Service, Austin, TX.

For primary bibliographic entry see Field 6G. W81-04025

SOME PRELIMINARY OBSERVATIONS ON THE SUBMERGED AQUATIC ZOSTERA CA-PENSIS SETCHELL,

University of Durban-Westville (South Africa). Dept. of Botany.

D. J. Edgecombe.

Journal of South African Botany (Cape Town), Vol 46, No 1, p 53-66, 1980. 10 Fig, 7 Ref.

Descriptors: *Zostera capensis, *Submerged plants, *Aquatic plants, *Sea grasses, Southern Africa, Plant growth, Plant morphology, Plant populations, Leaves, Rhizomes, Life cycles, Seeds, Salinity, Marine plants, Coastal waters.

Field and laboratory investigations were conducted on the life cycle and morphology of the submerged macrophyte *Zostera capensis* so that measures may be taken to restock and protect this highly productive seagrass. *Zostera capensis* is widely distributed along the east coast of Southern Africa, but the *Zostera* beds have been reduced by man and by deleterious environmental effects. The plant has a creeping rhizome system and erect turions or leaves. The erect turions vary from 30 to 900 mm in length. Reproductive shoots have a variable number of peduncles each terminated by a spadix. The spadices contain both male and female flowers. The reddish brown seeds are ellipsoid and are 2.6 - 3.0 mm in length. Seeds were germinated in the laboratory at 18 °C with a salinity of 20% and a photoperiod of 12 hours. After one year the plant consists of a branched rhizomatous system, with five to eight vegetative shoots, and two to four reproductive shoots. *Zostera* has a flowering period of about 4 months. Preliminary laboratory investigations indicate that *Zostera* is able to tolerate changes of salinity, temperature, photoperiod, and light intensity. More research is planned with

emphasis on flowering and germination. (Seigler-IPA) W81-04026

SEDIMENT ACCUMULATION RATES AND GEOCHRONOLOGIES MEASURED IN THE SAGUENAY FJORD USING THE PB-210 DATING METHOD,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.

J. N. Smith, and A. Walton.

Geochimica et Cosmochimica Acta, Vol 44, No 2, p 225-240, 1980.

Descriptors: *Sedimentation, *Fjords, Lead, Cores, Stratigraphy, *Saguenay Fjord, Canada, Radioactive dating, Dating, Geochemistry, *Sedimentation rates.

Nine 10 cm diameter PVC 'Lehigh' gravity cores were collected at seven stations during the April 1976 cruise of the CSS Hudson in the Saguenay Fjord, Quebec. The Saguenay Fjord occupies a drowned valley, 70 km long and 1-6 km wide, incised into the crystalline rocks of the Canadian Shield. The Fjord is composed of several deep basins bridged by shallow sills. Surface water salinities increase downstream from 0.5 to 28‰ near the mouth of the fjord and reach 31‰ at depths of 250 m. Suspended matter concentrations ranged from 10 mg/liter near the head of the fjord to less than 0.25 mg/liter in its deep inner basin. Sediment accumulation rates decreased with increasing water depth and distance from the head of the fjord. Pb-210 geochronologies estimated using combinations of the 'constant flux-constant sediment accumulation rate', 'constant initial concentration', and 'constant flux' models are generally in good agreement with time-stratigraphic sediment horizons determined from Cs-137 activity profiles. Layered sediment structures having different physical properties and composition observed in the sediments at the head of the fjord are related to recent inputs of Mer de la Flammé marine sands and clays displaced by a landslide in 1971. Approximately synchronous depositional anomalies observed in Pb-210 activity profiles in several cores may be related to widespread slumping or to other types of sediment redistribution processes associated with disruptions in the flow of the Saguenay River during construction of hydroelectric generating stations in the 1920s and 1930s. (Baker-FRC) W81-04063

THE MAJOR-ELEMENT CHEMISTRY OF SUSPENDED MATTER IN THE AMAZON ESTUARY,

Edinburgh Univ. (Scotland). Grant Inst. of Geology.

E. R. Sholkovitz, and N. B. Price.

Geochimica et Cosmochimica Acta, Vol 44, No 2, p 163-171, 1980. 10 Fig, 3 Tab, 24 Ref.

Descriptors: *Estuaries, *Suspended load, Sedimentation, Silt load, *Amazon Estuary, Amazon River, Chemical composition, Aluminum, Silicon, Potassium, Magnesium, Calcium, Phosphorus, Iron, Manganese, Metals, Salinity, *Chemical properties.

Samples were collected of suspended matter on surface waters in the Amazon Estuary and River during May and June of 1976. The total suspended load of the surface waters decreased dramatically from over 500 to 3 mg/liter as the salinity increased from 0 to 10‰. The high suspended loads in the upper estuary result from the resuspension of bottom sediments, as the surface water of the Amazon River itself only carried a suspended load of 50-70 mg/liter in its lower reaches during the study period. The rapid fall-off in total suspended load suggests deposition of particles. The water appeared distinctly brown in color when salinities were between 0 and 10‰. At approximately 10‰ there was a sharp transition to green colored water containing much diatomaceous debris. At salinities above 25‰ the water was distinctly blue. With the onset of biological productivity at about 10‰, there were large increases in the Si/Al and P/Al ratios, accompanied by smaller and significant in-

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Use Of Water Of Impaired Quality—Group 3C

creases in the ratios of Ca/Al, Mg/Al, Ti/Al and Mn/Al. Ratios of K/Al and Fe/Al showed very slight increases. A broadly proportional relationship existed between the concentrations of excess P and excess Si, Mg, Ti, Mn, K, and Fe, in water with salinity greater than 10%. This finding supports the conclusion that Si, P, Ca, Mg, Ti and Mn are incorporated into the skeletal and organic phases of marine phytoplankton, predominantly diatoms, of the Amazon Estuary. (Baker-FRC)

W81-04064

DIMETHYLSULFOXIDE IN MARINE AND FRESHWATERS.

Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W81-04128

A FLUSHING MODEL OF ONSLOW BAY, NORTH CAROLINA, BASED ON INTRUSION VOLUMES.

Skidaway Inst. of Oceanography, Savannah, GA.
L. P. Atkinson, and L. J. Pietrafesa.
Journal of Physical Oceanography, Vol 10, No 3, p
472-474, March, 1980.

Descriptors: *Bays, *Flushing, *Model studies, Upwelling, Ocean circulation, Subsurface water, Marine hydrologic models, Meanders, Eddies, Water currents, Gulfs, Hydrothermal studies, Estuaries, Flows, *Onslow Bay, North Carolina, Dilution curves, Pollutants.

A flushing model for Onslow Bay, North Carolina, was developed based on the concept of discretely intruding water masses. To demonstrate the model, observed parameters of 5 and 20 day periods and 20% dilutions were used as typical values. The model indicates that 20 to 60 days are required for 50% dilution of the bay to occur. The model estimates are comparable to other previous calculations of flushing time, and have potential application for describing minimum and maximum dilution times. (Titus-FRC)

W81-04143

HOW HIGH DO THE WATERS FLOW.

New Haven City, CT.
H. F. Goetz, Jr.
Water and Wastes Engineering, Vol 17, No 7, p
52-53, July, 1980. 3 Fig, 1 Tab.

Descriptors: *Elevation, *Water level fluctuations, *Graphical analysis, Tidal waters, Tidal effects, Harbors, *Estuaries, *Connecticut, New Haven Harbor.

A new method for determining water surface elevations was developed, which allows data relating to these elevations to be efficiently analyzed for cost effective results. Sufficient scientific data have been gathered in New Haven Harbor and its estuaries to allow the selection of the proper water surface elevation controls. Water surface elevations within the New Haven, Connecticut, harbor and its estuaries were measured and found to vary according to the size and shape of each estuary and the location of the gaging station. Water surface elevation is a measurement of the flow from ocean or tidal waters not the flow from land or flood waters. Information on gaged differences in water surface elevations and the elevation curve for Long Island Sound were combined to permit the construction of elevation-frequency curves for New Haven Harbor. The proper water surface elevations can be selected for various hydraulic projects. (Small-FRC)

W81-04146

COMMENTS ON TIDALLY INDUCED RESIDUAL CURRENTS IN ESTUARIES: DYNAMICS AND NEAR-BOTTOM FLOW CHARACTERISTICS.

Naval Underwater Systems Center, New London, CT.
J. P. Iannelli.
Journal of Physical Oceanography, Vol 11, No 1, p
126-134, January, 1981. 6 Fig, 18 Ref.

Descriptors: *Tidal currents, *Tidewater, *Estuaries, Coasts, Estuarine environment, Water currents, Flow pattern.

Eulerian and Lagrangian currents in narrow tidal channels are interpreted in terms of the factors controlling their structure. These factors are the depth integrated value, the second-order velocity gradients at the bed and the surface, and the vertical structure of the driving terms in the time-averaged, second-order momentum equations. The Lagrangian current is obtained by adding the Stokes current to the Eulerian current. The Stokes current is landward at all depths and increases from zero to a maximum in the upper quarter of the water column. Breadth and depth constrictions of 25% or greater lead to strong bottom-flow convergences. The surface boundary condition used in most earlier studies is demonstrated to be incorrect. This effect is most important in the upper part of the water column for the short-channel, constant-breadth-and-depth analysis. (Small-FRC)

W81-04223

WET AND DRY REMOVAL OF TROPOSPHERIC FORMALDEHYDE AT A COASTAL SITE.

Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2D.
W81-04231

SOME PROBLEMS ON THE PRESERVATION OF ESTUARY WITH SPECIAL REFERENCE TO ECOLOGY OF GAMO-LAGOON, TOHOKU UNIV., SENDAI (JAPAN).

Faculty of Science, E. Kikuchi, K. Hanawa, and Y. Kurihara.

Japanese Journal of Limnology, Vol 41, No 3, p
117-123, July, 1980. 15 Fig, 1 Tab, 3 Ref.

Descriptors: *Lagoons, *Water circulation, *Conservation, *Tidal effects, *Saline water, Estuaries, Ecology, Water pollution control, Water pollution effects, *Gamo Lagoon, Japan, Birds, Water birds, Salinity, Organic matter, Urbanization, Benthic fauna.

The ecology of Gamo Lagoon, Japan, was surveyed during July 1978 to determine possible conservation measures. This lagoon, a well-known resting and feeding place for migratory birds, such as waders, snipes, and plovers, has suffered from the effects of human activities—urbanization, harbor construction, industrialization, and fish culture. A large accumulation of organic pollutants in bottom sediments of the interior region and the infauna of the benthic fauna was attributed to a lack of efficient sea water exchange. Although a connection between the lagoon and the open sea could improve water circulation and quality, salinity and organic matter variations may adversely affect present fauna. (Cassar-FRC)

W81-04295

TIDAL SEDIMENT TRANSPORTATION AND BEHAVIOR OF PARTICULATE PHOSPHORUS AND HEAVY METALS IN A POLLUTED TIDAL RIVER.

Aichi Environmental Research Center, Nagoya (Japan).
For primary bibliographic entry see Field 5B.
W81-04296

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SEMPERMEABLE MEMBRANES OF COPOLYAMIDES,

Bayer A.G., Leverkusen (Germany, F.R.). (Assignee).
K. Elfring, G. D. Wolf, F. Bentz, and H. E. Kunzel, U.S. Patent No. 4,217,227 8 p, 10 Ref. Official Gazette of the United States Patent Office, Vol 99, No 2, p 617, August 12, 1980.

Descriptors: *Patents, *Desalination, *Water treatment, *Separation techniques, Semipermeable membranes, Desalination apparatus, Water purification, Filtration.

A porous semipermeable membrane is described for inverse osmosis and ultra filtration of highly-concentrated salt solutions consisting essentially of a fully aromatic copolyamide. The membrane has a water absorption capacity of from 4.5 to 10% by weight preferably from 4.5 to 8% by weight as measured on approximately 40 micron thick symmetrical films at room temperature and 65% relative air humidity. It has high throughflow rates coupled with high selectivity. Examples of the technical application of this separation process are the desalination of sea water or brackish water, the purification of contaminated water for the production of drinking water or industrial water, and the concentration, removal or recovery of a variety of different substances from aqueous solutions. (Sinha-OEIS)

W81-04083

PROCESS FOR COMPLETE OR SELECTIVE REMOVAL OF SALTS FROM AQUEOUS SOLUTION,

J. Dale, and G. Borgen.
U.S. Patent No. 4,216,083, 4 p, 9 Ref. Official Gazette of the United States Patent Office, Vol 99, No 1, p 217-218, August 5, 1980.

Descriptors: *Patents, *Desalination, *Water treatment, *Waste water treatment, Adsorption, Activated carbon, Saline water, Alkaline earth metals, Separation techniques, Polyethers, Regeneration, Product recovery.

A process for complete or partial extraction of salts from aqueous solution, in order to pruify such solutions, or in order to remove certain salts selectively and to recover these is described. Polyethers, particularly those which are formally derived from ethylene glycol and are readily prepared industrially from ethylene oxide, may be adsorbed from aqueous solution to the surface of granulated active carbon in an amount of up to 10% of the weight of the carbon, and can then be eluted by use of water. The resulting moist polyether-impregnated active carbon, preferably containing 4 to 6% of polyether, suitably packed in a column, has been found to have the ability to absorb salts, particularly alkali and alkaline earth metal salts, particularly with inorganic anions such as nitrate, halide, sulphate, phosphate, etc., more or less completely and more or less selectively, from aqueous solution. Recovery of the adsorbed salt and regeneration of the column may be carried out with a suitable solvent. (Sinha-OEIS)

W81-04101

3C. Use Of Water Of Impaired Quality

EPA POLICY ON LAND TREATMENT AND THE CLEAN WATER ACT OF 1977,

Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.

W81-04135

CONSIDER THE MANY REASONS FOR REUSE,

R. von Dohren.
Water and Wastes Engineering, Vol 17, No 9, p
74-78, September, 1980.

Descriptors: *Water reuse, *Reclaimed water, *Irrigation, Waste water disposal, Impaired water use, Water sources, *California.

Although the Northern California region normally has an abundant, inexpensive water supply, there are possible cost benefits from reclamation and reuse of water during droughts and in the case that more water is transported to Southern California. Use of reclaimed waste water could reduce surface water pollution, energy demands, costs to industry, fertilizer requirements, and operation and mainte-

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3C—Use Of Water Of Impaired Quality

Finance costs. It could permit preservation of open lands by setting aside areas for effluent disposal, double cropping, power generation, and wetlands formation. A method of reusing waste water involves reclamation during periods of low stream flow (summer) and discharge during periods of wet weather (winter). (Cassar-FRC)
W81-04158

3D. Conservation In Domestic and Municipal Use

PERCEPTION INFLUENCES WATER CONSERVATION SUCCESS,
California Univ., Berkeley, Dept. of Social and Administrative Health Sciences.
For primary bibliographic entry see Field 6D.
W81-04196

3F. Conservation In Agriculture

A KIBBUTZ THAT'S BIG ON SPRAYERS,

N. Abbott.
Farmer's Weekly (Moheni Natal), p 42-43, 45, January 2, 1980. 7 Fig.

Descriptors: *Sprayers, *Agricultural engineering, *Israel, *Agriculture, Agricultural chemicals, Horticulture, Pesticides, Spray-booms, Irrigation practices, Nozzles, Herbicides, Farms, Farm equipment.

The Degania Bet kibbutz, one of the oldest kibbutzim in Israel, operates the Degania Sprayer Factory which produces high-quality, rugged and low-maintenance sprayers with a variety of options. The factory produces about 1,400 agricultural sprayers annually. Degania follows a design philosophy of 'the production of basic units with a variety of adaptations and options so that the factory can custom-make -- to suit individual orders'. The sprayers do not become obsolete as improvements are made and owners of early models can still attach even the most modern spray booms to their models. Current design emphasis centers on ultra-low-volume (ULV) spray techniques and on a new kind of citrus sprayer. Medium-volume sprayer techniques are currently the most popular in Israel, but the move to ULV spraying is expected due to the rapidly rising price of agrochemicals, Degania's line of sprayers ranges from a 100-liter wheelbarrow sprayer to the 2,000-liter articulated orchard sprayer. The spray-boom design is stressed and boom lengths vary from 5 to 18 m. Orchard blowers are also included in the Degania line. (Seigler-IPA)
W81-04035

WINDMILLS -- A NEW CONCEPT,

N. Snyman.
Farmers Weekly (Moheni Natal), p 18-19 and 21, March 12, 1980. 7 Fig, 1 Tab.

Descriptors: *Windmills, *Pump wells, *Compressed-air, *Fuel, Boreholes, Wind velocity, South Africa, Irrigation water, Irrigation wells, Air compressors, Spray irrigation, Water supply, Water supply development.

Barry Payne of Durban, South Africa, has invented a wind powered air compressor that is capable of pumping water from boreholes long after the wind has stopped blowing. The wind wheel of the new invention is an ordinary 1.8 m windmill wheel with only six vanes. It turns a shaft that is connected to a two-piston air compressor. The wind wheel and air compressor are mounted with bearings on top of a tubular tower so that the tall can keep the wheel facing into the wind. Air is pumped into the top section of the tubular tower which serves as a compressed-air tank. The base of the tower also serves as an air reservoir. A relief valve blows off when the maximum pressure is reached. Once stored the air can be metered out to the work load on demand. The windmill begins operating at winds of 5 km/h and operates about 80% of the time. Advantages of the new concept include the following: it can be erected away from the bore-

hole, it can pump from more than one source at a time, gusty wind conditions are fully exploited, pumping can be stopped by turning off an air valve, erection is simple, air reservoirs can be made from any piping, only one size wind wheel is needed, and pumping can continue after the wind has stopped. (Seigler-IPA)
W81-04036

(Assignee).
E. M. Troup.
U.S. Patent No 4,216,913, 6 p, 7 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 512, August 12, 1980.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation practices, Irrigation efficiency, Irrigation operation, Maintenance.

An improved nozzle and method of operation is described for use in irrigation sprinklers of the impact and reaction drive types and by which water may be evenly distributed over the range of the sprinkler even when operating at relatively low supply pressures. This is accomplished generally by a nozzle in which the stream of water flowing through the sprinkler converges in a pyramidal shaped passage and is released from the nozzle through a polygonal orifice formed at the end of the pyramidal passage. While flowing through the pyramidal passage a substantial secondary flow is developed which causes the stream ejected from the nozzle to include a number of fins comprised of relatively small droplets of water to break away from the main stream of water. In this way, the desired distribution of water is achieved, and the sprinkler can be operated at a relatively low supply pressure. (Sinha-OEIS)
W81-04092

IRRIGATION WATER DISCHARGE VALVE,

N. S. Standal.

U.S. Patent No 4,216,794, 14 p, 15 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 470, August 12, 1980.

Descriptors: *Patents, *Irrigation systems, *Application equipment, Valves, Irrigation practices, Automatic control, Irrigation efficiency, Irrigation operation and maintenance.

The irrigation apparatus is designed to automate sprinkling of a field by use of a wheel-supported lateral pipeline having sprinklers spaced along a center pipeline axis. A lateral pipeline is selectively supplied with water from a stationary water supply line having water discharge valves spaced along its length. The apparatus is alternately in a stationary mode adapted to be hydraulically coupled to the water supply line through a selected water discharge valve, or in a traveling mode uncoupled from the water supply line and with the lateral pipeline powered for movement in a direction parallel to the supply line. The combination comprises a carriage guided along the water supply line, a structural fluid connection between the lateral pipeline and the carriage and sensing means for indexing the carriage by reference to a selected water discharge valve. A valve actuator on the carriage completes the hydraulic circuit from the water supply line to the lateral pipeline through the structural fluid connection. The entire apparatus is controlled sequentially from the carriage. (Sinha-OEIS)
W81-04094

CROP PRODUCTION FUNCTIONS AND THE ALLOCATION AND USE OF IRRIGATION WATER,

Knight (Sinclair) and Partners Ltd., Bandung (Indonesia).

J. W. H. Barrett, and G. V. Skogerboe.

Agricultural Water Management, Vol 3, No 1, p 53-64, 1980. 4 Fig, 25 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Water allocation, Crop production, Irrigation practices, Transpiration, Water loss.

Factors influencing irrigated crop production functions are briefly reviewed. Crop yield-water use functions include linear functions such as the relationship found between dry matter yield and transpiration for grain sorghum, wheat, oats, and millet. Non-linear relationships have also been found, including a diminishing curvilinear relationship between yield and applied water for maize, grain sorghum, and wheat. These conflicting results happen because when water is applied in excess of

Groundwater Management—Group 4B

the amount required for maximum yield, water use (and to some extent, evapotranspiration) increases while water yield remains constant or decreases. If water logging decreases soil aeration, the yield is reduced further. Thus, the curvilinear nature of the function may result because a portion of the applied water is unavailable. The optimal depth of water to apply will always be in excess of the potential evapotranspiration of the crop. (Small-FRC)
W81-04288

FREQUENCY AND DEPTH OF IRRIGATION FOR GROUNDNUT
Andhra Pradesh Agricultural Univ., Tirupati (India). Dept. of Agronomy. G. Bhanu Reddy, S. Rami Reddy, and C. H. Sankara Reddi. Agricultural Water Management, Vol 3, p 45-51, 1980. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Irrigation effects, Water allocation, Crop production, Evapotranspiration, India, Peanuts.

The effects of frequency and depth of irrigation on groundnut production were investigated over two summer seasons at the Andhra Pradesh Agricultural University in India. Four irrigation frequencies and three depths of irrigation water were tested in a randomized block design with three replications. Nitrogen, phosphorus, and potassium were applied at sowing. The test crop was Arachis hypogaea, a bunch groundnut cultivar of about 105 days duration. When the total quantity of irrigation water was kept the same, high frequency irrigation gave the highest yield. At each irrigation frequency, highest yields were obtained when the depth of applied water was equal to that lost in evapotranspiration. Lower yields resulted with low irrigation frequency and low depth of irrigation. Increased yields were due to optimal available moisture and nutrients in the root zone. Thus, on sandy loam soils of poor water retentive capacity, high yields can be obtained with frequent irrigations, with the depth of water applied being equal to that lost in evapotranspiration. (Small-FRC)
W81-04289

DECISION MODELS FOR OPTIMAL CROPPING PATTERNS IN IRRIGATIONS BASED ON CROP WATER PRODUCTION FUNCTIONS, Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering. R. Kumar, and S. D. Khepar. Agricultural Water Management, Vol 3, No 1, p 65-76, 1980. 7 Tab, 7 Ref.

Descriptors: *Irrigation efficiency, *Crop yields, *Mathematical models, Water allocation, Crop production, Irrigation effects, Agriculture, India.

The usefulness of alternative levels of water use over the fixed yield approach was demonstrated when there was a constraint on water. Multicrop farm models were used which included a water production function for each crop. Thus, alternative levels of water could be selected, depending upon water availability. Water production functions (square root and quadratic type) based on experimental data for the following irrigated crops were used: wheat, gram, mustard, berseem, sugarcane, paddy, and cotton. The fixed yield model was modified by adding the stepwise water production functions using a separable programming technique. The models were applied to a selected canal command area, and optimal cropping patterns were determined. Also, sensitivity analysis was conducted for land and water resources. This analysis clearly indicated that the concept of alternative levels of water use is superior to the fixed levels approach for optimum utilization of land and water resources. (Small-FRC)
W81-04290

SUGARCANE RESPONSE TO IRRIGATION AND STRAW MULCH IN A SUBTROPICAL REGION, Punjab Agricultural Univ., Ludhiana (India). Dept.

of Soils. B. S. Sandhu, S. S. Prihar, and K. L. Khera. Agricultural Water Management, Vol 3, No 1, p 35-44, 1980. 3 Fig, 4 Tab, 18 Ref.

Descriptors: *Irrigation effects, *Mulching, *Sugarcanes, Moisture stress, Mulches, Straw, Growth rates, Crop yield, Arid climates, India.

The effects of pre-monsoon irrigation and straw mulching were determined on the hydrothermal regime of soil, and yield and quality of sugarcane. Field experiments were conducted in Northern India over a three year period. Three irrigation schedules based on ratios of 0.50, 0.75, and 1.0 times pan evaporation, and two levels of paddy straw mulch of 0 and 6 tons/ha were evaluated. Both irrigation and straw mulching had favorable effects on sugarcane height and yield. Cane yield was 13.8% higher with mulch than without it, and 13.8% higher with irrigation based on 1.0 times pan evaporation than that based on 0.5 times pan evaporation. The pan evaporation ratio of 0.5 gave a higher yield with mulch than irrigation with a ratio of 1.0 times pan evaporation did without mulch. Beneficial effects were attributed to better soil moisture and more favorable temperature regimes realized with mulching. The quality of the cane juice was not affected by the various experimental regimes. Thus, sugarcane production could be increased by using straw mulching and irrigation during the early growing season before the monsoons. (Small-FRC)
W81-04291

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

RESTORING THE FLORIDA EVERGLADES, A. R. Marshall. In: Proceedings, U.S. Fish and Wildlife Service Workshop on Coastal Ecosystems of the Southeastern United States, Big Pine Key, Florida, 18-22 February 1980. Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/79, February, 1981, p 153-160, 3 Fig.

Descriptors: *Wetlands, *Rehabilitation, *Resources management, *Water management, Laminar flow, Surface flow, Wildlife, Habitats, Water level, Flooding, Drainage effects, *Everglades, Florida.

The Florida Everglades is an array of interdependent and integrated lakes, rivers, canals, ponds, sloughs, marshes, swamps, tree hammocks, mangrove forests, shorelines, islands, estuaries, and bays. About 3,900-5,200 sq km of wetlands have been drained or severely degraded by partial drainage. Changes in seasonal flooding, water levels, fresh water inflow to bays and estuaries, wildlife habitats, and organic soil formation have resulted from drainage and water management programs. Efforts to restore the Everglades require departures from conventional goals, and it is neither possible nor desirable to undo the whole system of water management at this time. The following five first-stage objectives are proposed: restoration of the Turner River; reestablishment of surface water connections between the Big Cypress Reserve and Conservation Area Three; restoration of sheet flow in the Holey Land and Rotenberger Tracts and in Conservation Area Three; refilling of portions of canals 111, 109 and 110; restoration of sheet flow in the northeastern sector of the Shark River Slough. (Moore-SRC)
W81-04023

GUIDE TO THE USE OF HERBICIDES ON AQUATIC PLANTS

Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst. D. J. Steyn, W. E. Scott, P. J. Ashton, and F. S. Vivier.

Technical Report No TR 95, July, 1979. 32 p, 6 Tab, 3 Ref, 1 Append.

Descriptors: *Aquatic weed control, *Aquatic plants, *Herbicides, *Chemcontrol, Monitoring, *South Africa, Limnology, Pesticides, Spraying Environmental effects, Reservoirs, Vegetation effects, Legal aspects, Oxygen depletion, Decomposing organic matter.

A user and decision making guide is presented covering the many factors involved in the planning and implementation of an aquatic weed control program. Early recognition of a potential aquatic weed problem followed by immediate action is the best solution. In most cases the use of herbicides is the quickest, cheapest, and most successful control method, however, this does not apply for submerged weed for which no herbicides are yet registered. The limnology of the impoundment to be treated should receive attention as any successful chemical weed control program will result in some decomposing plant material which could result in deoxygenation. Also, the use of any herbicide in aquatic plant control is subject to several legal requirements of all levels. Some of the herbicides that are registered for the control of aquatic plants are: Amitrole, Diquat, Glyphosate, Propop, and Terbutryn. Diquat's mode of action is contact while the others are all systemic. Once the proper herbicide has been selected, successful control on the method of spraying and efficient follow-up operations. Monitoring and record keeping are required for extensive weed control programs. No herbicide should be used without considering the warnings and precautions concerning health aspects and the effects on animal life. (Seigler-IPA)
W81-04033

ENVIRONMENTAL ASPECTS OF THE YARE BASIN FLOOD CONTROL STUDY, Anglian Water Authority (England). North and Suffolk River Div. For primary bibliographic entry see Field 6G. W81-04226

4B. Groundwater Management

WASTE WATER CONTAMINATE REMOVAL FOR GROUNDWATER RECHARGE AT WATER FACTORY 21, Stanford Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5D. W81-04015

THE EFFECT OF INFILTRATION DISTRIBUTION ON ARTIFICIAL RECHARGE SCHEMES, Thessaloniki Univ., Salonika (Greece). School of Technology. P. Latinopoulos. Journal of Hydrology, Vol 49, No 3/4, p 279-286, February, 1981. 6 Fig, 4 Ref.

Descriptors: *Groundwater movement, *Infiltration, Hydrology, Groundwater runoff, Water table fluctuations, *Artificial recharge, Recharge, *Groundwater recharge, Induced infiltration, Replenishment, Geohydrology, Groundwater management.

An analytical solution of the transient groundwater flow is presented in this study so that quantitative relations between the time-dependent input to an aquifer and the corresponding groundwater response may be derived. The effect of a varying natural infiltration on the groundwater response was determined to be of relative importance, with groundwater response also being influenced by the characteristics of the aquifer. Artificial recharge offers several advantages which are still dependent on many factors, and design criteria should therefore be examined carefully in every case of application. Using a simple recharge scheme taken as an example to obtain a long-term approximation, it was concluded that existing data for the aquifer properties and the infiltration distribution over time played a decisive role when planning for such schemes. Aquifers with low transmissivity and

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

high storage values together with a moderate throughout-the-year infiltration distribution seem the most efficient for artificial recharge, from the viewpoint of long-term regulation of the groundwater output. (Baker-FRC)
W81-04072

4D. Watershed Protection

PRACTICAL USES OF THE ANSWERS MOEL IN BMP PLANNING: AN ALLEN COUNTY EXPERIENCE,
Soil Conservation Service, Fort Wayne, IN.
For primary bibliographic entry see Field 5G.
W81-03973

WATER QUALITY: SEDIMENT AND NUTRIENT LOADINGS FROM CROPLAND,
Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 5G.
W81-03974

CONSERVATION TILLAGE PRACTICES TO CONTROL AGRICULTURAL POLLUTION,
Honey Creek Watershed Project, Tiffin, OH.
J. P. Crumrine, and D. U. Wurm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646. Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980, p 301-307, 5 Tab, 9 Ref.

Descriptors: *Soil conservation, *Phosphorus removal, *Agricultural watersheds, *Soil erosion, *Water quality control, *Cost-benefit analysis, Crop production, Farms, Soil management, Rate of return, Economic impact, Nutrient removal, Agricultural wastes.

The first two years results of a three-year project aimed at reducing soil and phosphorus loss from an agricultural watershed in north-central Ohio are reported. Conservation tillage, either reduced tillage or no-till, was compared with conventional tillage to determine the effects on erosion and phosphorus transport, and the cost-effectiveness of these practices. Compared with conventional tillage, reduced tillage reduced soil loss by 40% and no-till reduced soil loss by 76%. Assuming an effectiveness of 75%, phosphorus transport would be reduced 30% by reduced tillage and 57% by no-till. Payments to landowners for implementing the program ranged from \$125/acre for no-till in 1979 to \$24/acre for reduced till in 1980. When acre accomplishments without benefit of monetary assistance are included the figures drop to \$15/acre for no-till and \$5/acre for reduced tillage in 1980. With all acreage and all funding included, the costs of retaining a ton of soil were \$2.9 and for retaining a kilogram of phosphorus were \$53-248, with the reduced tillage being the more costly. Reduced tillage gave the best return to the farmer, \$107/acre, with \$85/acre returned from conventional treatment and \$73 from no-till, in the first year. Practice application costs may initially be great, but unit costs will decrease with time and as spin-off benefits occur. (Brambley-SRC)
W81-03981

WATER REPELLENT SOILS: A STATE-OF-THE ART,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
For primary bibliographic entry see Field 2G.
W81-04016

FLOODPLAIN REGULATION IN ONTARIO: AN ANALYSIS OF EXISTING AND PROPOSED POLICY IN THE GRAND AND CREDIT RIVER WATERSHEDS,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W81-04160

5. WATER QUALITY MANAGEMENT AND PROTECTION

CONSERVATION TILLAGE PRACTICES TO CONTROL AGRICULTURAL POLLUTION,
Honey Creek Watershed Project, Tiffin, OH.
For primary bibliographic entry see Field 4D.
W81-03981

5A. Identification Of Pollutants

HIGH FLOW WATER QUALITY STANDARDS,
Southeastern Wisconsin Regional Planning Commission, Waukesha.
For primary bibliographic entry see Field 5C.
W81-03983

INTERLABORATORY, MULTIMETHOD STUDY OF AN IN SITU PRODUCED OIL SHALE PROCESS WATER,

Department of Energy, Laramie, WY. Laramie Energy Technology Center.

D. S. Farrir, R. E. Poluson, and F. P. Fox.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, Colorado. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980, p 182-210, 9 Tab, 39 Ref.

Descriptors: *Process water, *Oil shale, *Water analysis, *Chemical composition, Elements, Water quality, Detection limits, Water pollution, Pollutants, Metals.

To obtain a careful chemical characterization of an oil shale process water designated for wide use in environmental research and to determine the suitability of existing analytical methods for this characterization an interlaboratory, multimethod study was conducted. The process water sample is known as Omega-9 and was shown to be homogeneous. Samples were sent to 13 laboratories for detailed elemental and water quality parameter analyses. Values for 72 elements and 28 water quality parameters were obtained. Thirty-two elements and 16 water quality parameters were detected by two or more laboratories or techniques and fair agreement was obtained; a range was reported for 6 elements and 3 water quality parameters; 22 elements and 1 water quality parameter were below the detection limit of all techniques used; and only a single measurement was used for 12 elements and 8 water quality parameters. Neutron activation analysis, x-ray fluorescence spectrometry, and atomic absorption spectroscopy gave the most consistent and accurate results but spark source mass spectrometry detected more elements than any other technique and consistently had the lowest detection limit. Many of the analytical techniques investigated are inadequate for the analysis of oil shale process waters because of the interferences, and extremely high or low levels of constituents. Some significant interference problems in Omega-9 are discussed, and instrumental, chemical and other analytical techniques are recommended. (Brambley-SRC)
W81-03990

RETORT WATER PARTICULATES.

California Univ., Berkeley. Lawrence Berkeley Lab.

J. P. Fox.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, CO. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980, 226-250 p, 12 Fig, 4 Tab, 6 Ref, W-7405-Eng-48.

Descriptors: *Oil shale, *Process water, *Particulate matter, *Morphology, Chemical composition,

Bacteria, Oil, Crystals, Emulsions, Filtration, Elements, Metals.

Particulates were collected from 11 retort waters and their chemical composition and morphology studied using x-ray fluorescence spectrometry, x-ray diffraction and scanning electron microscopy. This work indicates that the particulate fraction of retort water consists of oils and tars, spent shale fines and bacterial cells. Crystals and finely dispersed slats may form during or after vacuum filtration and contribute to the particulate fraction. The crystal phase aragonite was positively identified in one sample. These particulates originate from the suspension of spent shale fines and the formation of an oil-water emulsion during retorting, from the evaporation of an equivalent 1-mm-deep layer of retort water from the filter surface, from carbon dioxide outgassing during filtration and from bacterial growth in samples maintained at < 4 C. The elements calcium, magnesium, iron, silicon, aluminum, potassium, sodium, nickel, barium, and chromium may be localized in individual particles and are major elements in the particulates. About one percent of the total potassium, arsenic, selenium, bromine, and rubidium in retort water is present in the particulate fraction and significantly greater than one percent of the iron, chromium, mercury and nickel. The elements arsenic, selenium, rubidium, strontium, mercury, gallium, lead, yttrium, titanium, and manganese are uniformly distributed in the matter material and occur at low levels. The elements mercury, nickel, germanium, arsenic, bromine, iron, and selenium appear to be removed by the bacterial cells.
W81-03991

APPLICATIONS OF DISSOLVED ORGANIC CARBON FRACTIONATION ANALYSIS TO THE CHARACTERIZATION OF OIL SHALE PROCESSING WATERS.

Geological Survey, Denver, CO.

J. A. Leenheer, and D. S. Farrir.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, CO. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980, 273-285 p, 3 Fig, 13 Ref.

Descriptors: *Water analysis, *Oil shale, *Process water, *Organic carbon, *Water pollution sources, *Chemical composition, Organic loading, Organic compounds, Water quality, Monitoring, Surface water, Adsorption, Absorption.

Analytical and preparative-scale dissolved organic carbon (DOC) fractionation were used to study sorption of organic solutes from oil shale processing waters on processed shale and soil sorbents to predict the transport of these solutes in surface and groundwater systems. The flow schemes for both analytical and preparative-scale DOC fractionation were modified to deal with the high DOC loads, and high sulfur, carbonate and bicarbonate concentrations in the processing water. When the processes were compared, using simulated *in situ* retort and Omega-9 processing water, the preparative-scale process gave an increased percentage of hydrophobic solutes. Analytical DOC fractionation has been used as a water quality monitoring technique in the detection of oil process water discharges into surface streams, and is being used to assess the sorptive interactions with Omega-9 processing water with soil. Preliminary results show that the organic-base fractions are preferentially absorbed, whereas with processed shale the organic-acid fraction is preferentially absorbed. Fractions obtained from preparative-scale DOC fractionation have been further analyzed to identify individual compounds. Qualitative and quantitative information on the composition of processing waters and the natural waters that they may impact can be obtained. (Brambley-SRC)
W81-03992

BIOLOGICAL MONITORING OF OIL SHALE PRODUCTS AND EFFLUENTS USING SHORT TERM GENETIC ANALYSES.

Identification Of Pollutants—Group 5A

Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W81-03996

AQUATIC TOXICITY TESTS ON INORGANIC ELEMENTS OCCURRING IN OIL SHALE.
Thomas Hunt Morgan School of Biological Sciences, Lexington, KY.
For primary bibliographic entry see Field 5C.
W81-03998

AN ANALYTICAL METHOD FOR ASSESSING THE QUALITY, BY MICROBIAL EVALUATION, OF AQUEOUS EFFLUENTS OBTAINED FROM AN IN SITU OIL SHALE PROCESS.
Wyoming Univ., Laramie. Plant Sciences Div.
For primary bibliographic entry see Field 5C.
W81-03999

HINDRANCE OF COLIFORM RECOVERY BY TURBIDITY AND NON-COLIFORMS.
Delaware Univ., Newark.

D. S. Herson, and H. T. Victoreen.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113581. Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-097, August 1980. 78 p., 34 Fig., 11 Tab., 13 Ref.

Descriptors: *Coliforms, *Bacteria, *Turbidity, *Bacterial analysis, *Potable water, Water conveyance, Water quality, Chemical properties, Oxides, Organic matter, Water distribution, *Wilmington, Delaware.

Situations have been known to exist in the water distribution system of the Wilmington, Delaware water department where 1-2 coliforms per 100 ml had to be isolated from water containing a total of 100 to 100,000 total organisms/ml. In addition, coliforms must be detected in waters containing high levels of turbidity due to natural mineral turbidity, hydrated oxides, and organic debris. Coliform and non-coliform organisms were isolated and identified from Brandywine River source water and from the Wilmington Water Department distribution system. The outcome of the interaction between these two groups of organisms was found to be dependent upon numerous factors, including: the specific non-coliform, the number of each type of organism, the nutrient environment in which the interaction occurred, the physiological status of the interacting organisms, and the type of media used to recover the coliforms. Turbidity augmentation and reduction experiments were done to distinguish non-bacterial turbidity inhibition of coliforms from the inhibition caused by other bacteria. The more serious inhibition to coliform detection seemed to be caused by the large populations of non-coliforms which exceed the resident coliforms in water mains by factors of 100 to 100,000. Turbidity per se was not an impediment of coliform growth, but it did make it more difficult to recognize coliforms on membrane filters. (Moore-SRC).
W81-04004

DELTA WATER QUALITY CONDITIONS-IMPLEMENTATION OF WATER QUALITY STANDARDS OF DECISION 1485, CALENDAR YEAR 1979.

California State Water Resources Control Board, Sacramento.
Staff Report, March, 1980. 21 p., 10 Fig., 1 Plate.

Descriptors: *California, *Deltas, *Water quality standards, *Saline-freshwater interfaces, Water quality control, Saline water intrusion, Conductivity, Chlorides, Water quality management, Annual runoff, Intake gates, Data collections, Fish populations, Wildlife conservation.

In adopting Decision 1485, the State Water Resources Control Board set specific Delta water quality standards as conditions in permits of the federal Central Valley Project and State Water Project. Under this program, monitoring reports and information on Delta water quality conditions

during implementation of standards contained in Decision 1485 are available. This report summarizes Delta water quality conditions in 1979, which generally were found to be excellent. Most of the applicable water quality standards were met by wide margins. Although 1979 was classified as a dry year, all of the standards which would have been applicable during a wet year were or could have been met, with the exception of wet year standards for May-July Delta outflows and western Delta agricultural supplies for about the last month of the summer irrigation season. These good quality conditions were due largely to uncontrolled Delta outflows which occurred from January through mid-April, in May, and from early October through December. Also described in the report are water quality standards for municipal and industrial supply, agricultural supply, and fish and wildlife protection. (Garrison-Omniplan)
W81-04027

MONITORING OF POLLUTANTS IN WASTE WATER, SEWAGE, AND SEDIMENT,
Hawaii Univ., Honolulu. Water Resources Research Center.

R. Young, E. Shiroma, J. Demetriou, D. Wong, and S. Artman. Technical Memorandum Report No 61, December, 1980. 37 p., 5 Fig., 24 Tab., 21 Ref.

Descriptors: *Hawaii, *Pollutant identification, *Bioindicators, *Water pollution sources, *Waste water, *Sewage bacteria, Contaminants, Outfall sewers, Pesticide residues, Water pollution effects, Effluents, Chlorinated hydrocarbons, Heavy metals.

Concentrations of heavy metals and chlorinated hydrocarbons in sewage effluent in Honolulu were monitored in this two-part study. Part I discusses samples collected quarterly from Waipahu Incinerator quench water and from Sand Island and Honolulu waste water, which were analyzed for fifteen sediment samples related to both toxicants. Semi-annual sediment samples from the old and new Sand Island outfall sites were also examined. Based on the results of this work, there appears to be no significant or alarming level of the examined substances in the waste waters or sediments compared to data from the literature or from other Hawaiian waste waters and sediments. In Part II, levels of an expanded list of pollutants were also reported to be extremely low. These 65 substances, named 'priority pollutants' by the U.S. Environmental Protection Agency, were analyzed by city laboratory personnel with the assistance of project staff. Twenty-four flow-weighted composites were collected for the analysis of pesticides, metals, and base-neutral extractable compounds. Grab samples were collected for the determination of phenols, cyanides and volatile organics. Acid extractable compounds (phenols) were not detected in all waste water (< 0.1 micrograms per liter), and only a few base-neutral extractables were detected. Pesticides detected were dieldrin in the Mokapu and Waianae effluents and demeton in the Waianae effluent. Overall, the levels of priority pollutants were extremely low as expected. (Garrison-Omniplan)
W81-04030

DETERMINATION OF CHROMIUM(VI) IN WATER BY LOPHINE CHEMILUMINESCENCE.

Oregon State Univ., Corvallis. Dept. of Chemistry. D. F. Marino, and J. D. Ingle. Analytical Chemistry, Vol 53, No 2, p 294-298, February, 1981. 4 Fig., 4 Tab., 33 Ref.

Descriptors: *Analytical methods, *Chromium, Trace elements, Chemiluminescence, Water quality, Sampling, Pollutant identification.

The usefulness of the lophine-Cr(VI) chemiluminescence reaction for determining Cr(VI) concentrations in natural waters was investigated. The method proved to be rapid, sensitive, and specific for real samples. The method is usable directly without sample cleanup as a rapid screening test to evaluate whether water samples contain amounts close to the recommended 50 microgram/liter limit

of Cr(VI) for drinking water. A more accurate value can then be determined, using cleanup procedures, if the original estimate suggests this is necessary. Preconcentration should be used to determine accurately Cr(VI) levels below 1 microgram/liter. The use of an ion exchange resin for sample preparation allows the isolation or preconcentration of Cr(VI) from its potential interferences in less than 15 min. The limit of detection of Cr(VI) is 0.3 microgram/liter without preconcentration and 0.015 microgram/liter with a 20-fold preconcentration. (Baker-FRC)
W81-04058

CLEANING METHODS FOR POLYTHENE CONTAINERS PRIOR TO THE DETERMINATION OF TRACE METALS IN FRESHWATER SAMPLES,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences. D. P. H. Laxen, and R. M. Harrison. Analytical Chemistry, Vol 53, No 2, p 345-350, February, 1981. 2 Fig., 10 Tab., 24 Ref.

Descriptors: *Trace elements, *Metals, *Sampling, Analytical techniques, Sample containers, Water analysis, *Pollutant identification.

The determination of heavy metals in water presents certain problems. These contaminants are usually present at so low a level that contamination of the sample during the analytical procedure can become significant. Various methods for cleaning of sample containers with nitric acid, detergent and perchloric acid are compared to provide a more rational basis for the selection of a particular procedure. Based on this study it is recommended that a 48 hr soak with 10% nitric acid be used for both the preliminary cleaning of new bottles and routine cleaning. The results also support the suitability of polythene sample bottles for the collection and storage of freshwater samples prior to analysis for trace metals such as zinc, cadmium, lead, and copper. (Baker-FRC)
W81-04059

DETERMINATION OF INORGANIC ARSENIC(III) AND ARSENIC(V), 'METHYLARSENIC' AND 'DIMETHYLARSENIC' SPECIES BY SELECTIVE HYDROIDE EVOLUTION ATOMIC ABSORPTION SPECTROSCOPY,
Southampton Univ. (England). Dept. of Chemistry.

A. G. Howard, and M. H. Arbab-Zavar. Analyst, Vol 106, No 1259, p 213-220, February, 1981. 5 Fig., 5 Tab., 19 Ref.

Descriptors: *Arsenic, *Arsenic compounds, *Water analysis, *Pollutant identification, Analytical techniques, Spectroscopy, Metals, Chemical interference.

Arsenic in inorganic and organic forms was determined by reduction with sodium tetrahydroborate (III) to the respective arsines, selectively volatilizing into a heated quartz atomizer tube and detecting with atomic absorption spectroscopy. This method is applicable to the analysis of water and sediments. In a 10 ml sample, the detection limit was 0.025 ng arsenic per ml. At low pH (1 M HCl), arsenic(3+), arsenic(5+), methyl arsenic and dimethyl arsenic are reduced. At pH 5 only arsenic(3+) is reduced, allowing differentiation between species. Interference (depression of results) was produced by silver(1+), gold(3+), chromium(6+), iron(2+), iron(3+), germanium(4+), molybdenum(6+), antimony(3+), antimony(5+), tin(2+), manganese(7+), and nitrate. Pumped addition of EDTA before reduction masked interferences in some cases. (Cassar-FRC)
W81-04060

DISCREPANCIES BETWEEN THE O2 AND 14-C METHODS FOR MEASURING PHYTOPLANKTON GROSS PHOTOSYNTHESIS AT LOW LIGHT LEVELS,

Arthur Amtsveraasen (Denmark). J. M. Andersen, and K. Sand-Jensen. Oikos, Vol 35, p 359-364, November, 1980. 3 Fig., 26 Ref.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

Descriptors: *Water quality, *Phytoplankton, *Light intensity, Aquatic microorganisms, Aquatic environment, Photosynthesis, Carbon-14.

The oxygen and carbon-14 techniques for determining gross primary production of phytoplankton were compared under different light levels in field incubations in eutrophic Frederiksborg Slotso and in laboratory experiments. The gross oxygen production divided by carbon fixation ranged between 1.14 and 1.35 at light saturation. At low intensities of light this quotient increased to values ranging from 2 to 8. This finding is ascribed to an underestimation of gross photosynthesis by C-14 fixation rates due to reassimilation of respiration carbon dioxide. This reassimilation is significant at low levels of light intensity. It is suggested that the gross photosynthesis from carbon-14 fixation rates may be estimated by adding the same value at each light intensity down to the compensation point instead of using a constant multiplication factor. (Baker-FRC)
W81-04062

AN EXTRACTION-SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF NON-IONIC SURFACTANTS,
Sydney Univ. (Australia).
P. T. Crisp, J. M. Eckert, N. A. Gibson, and I. J. Webster.
Analytica Chimica Acta, Vol 123, p 355-357, 1981.
1 Tab, 2 Ref.

Descriptors: *Spectrophotometry, *Surfactants, Analytical techniques, *Pollutant identification, Detergents, Organic compounds, Surface waters.

Nonionic surfactants were detected in fresh water, estuarine, and sea water samples to a lower limit of 15 micrograms per liter (as Triton X-100) in a 150 ml sample. The samples were extracted into 1,2-dichlorobenzene with a reagent composed of zinc sulfate heptahydrate, potassium thiocyanate, and potassium acetate. Absorbance was measured by spectrophotometer at 560 nm after addition of 1-(2-pyridylazo)-2-naphthol and triethanolamine. Sulfide interference can be prevented by addition of 1 ml of 3% hydrogen peroxide solution; Fe(3+) and Al(3+) interference, by EDTA. (Cassar-FRC)
W81-04069

DETERMINATION OF SELENIUM IN WATER SAMPLES BY MOLECULAR EMISSION CAVITY ANALYSIS AFTER COPRECIPITATION,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
Th. A. Kouimtzis, M. C. Sofoniou, and I. N. Papadoyannis.
Analytica Chimica Acta, Vol 123, p 315-317, 1981.
1 Tab, 8 Ref.

Descriptors: *Selenium, *Water analysis, *Pollutant identification, Analytical techniques, Metals, Chemical precipitation.

Selenium in the 0.2-5 ppb concentration range was determined in spiked distilled water and spiked sea water samples. The method involves coprecipitation of the selenite form with hydrated iron (III) oxide, dissolving in HCl, reprecipitation as elemental selenium, and determination by molecular emission cavity analysis. Detection limit is 0.2 ppb, in a 250 ml water sample. If the selenium concentration is greater than 5 ppb, the coprecipitation step is unnecessary. (Cassar-FRC)
W81-04070

DETERMINATION OF COPPER BY ANODIC STRIPPING VOLTAMMETRY: ANOMALOUS BEHAVIOR IN SEA WATER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
R. J. Siebert, and D. N. Hume.
Analytica Chimica Acta, Vol 123, p 335-338, 1981.
1 Fig, 4 Ref.

Descriptors: *Sea water, *Copper, *Pollutant identification, Heavy metals, Metals, Analytical techniques, Lead, Copper, Trace elements.

Repeated determinations of copper in raw sea water by the anodic stripping voltammetric method showed increasingly smaller peaks after several cycles of plating and stripping using a Hg-coated graphite electrode. Cadmium and lead did not show this effect. Copper peaks also decreased upon cycling when NaCl was substituted for sea water. However, KNO₃ solutions and seawater acidified to pH 3.0 produced normal results. Small (5 ml) samples showed a larger drop in peak height than larger samples (25-50 ml). Apparently the stripping operation is more severely influenced by sea water than is the plating step. The formation of a Cu(+) electro-inactive substance adhering to the electrode surface is believed responsible for the anomaly. (Cassar-FRC)
W81-04071

UREA-LYSINE METHOD FOR RECOVERY OF ENTEROVIRUSES FROM SLUDGE,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.

S. R. Farrah, P. R. Scheuerman, and G. Bitton.
Applied and Environmental Microbiology, Vol 41, No 2, p 455-458, February, 1981. 3 Tab, 14 Ref.

Descriptors: *Viruses, *Sludge, *Urea-lysine method, *Flocculation, *Pollutant identification, Analytical techniques.

A procedure was developed to recover enteroviruses (polio-, echo-, and Coxsackieviruses) from several types of sludge: wasted sludge, aerobically digested sludge, and mixed liquor suspended solids. Added enteroviruses and indigenous viruses were recovered by treating sludge flocs with M urea-0.05 M lysine (pH 9), and the pH was adjusted to greater than 8.8 by addition of 1 M lysine (pH 11.5). After centrifugation and neutralization with lysine (pH 2), addition of 0.005 M aluminum chloride and sodium carbonate produced aluminum hydroxide flocs on which viruses were absorbed. EDTA-beef extract (pH 9) was used to dislodge the flocs, and viruses were further concentrated by reflocculation. The method has several disadvantages—several steps are involved, urea-lysine may inactivate the virus with time, and freshly prepared urea-lysine solutions are required. Advantages of the method are small sample volume, the fact that viruses in flocs can be distinguished from those in sludge liquor, and its usefulness in a variety of sludge types. (Cassar-FRC)
W81-04106

DETERMINATION OF GERMANIUM IN NATURAL WATERS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY WITH HYDRIE GENERATION,
Florida State Univ., Tallahassee. Dept. of Oceanography.

M. O. Andreac, and P. N. Froelich.
Analytical Chemistry, Vol 53, No 2, p 287-291, February, 1981. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Germanium, *Analytical techniques, *Water quality control, Sampling, Spectrometry, *Pollutant identification.

The combination of hydride generation and cold trapping for sample enrichment with two detection systems was investigated for determination of germanium in natural waters. One of the detection systems was the quartz cuvette burner atomic absorption detector used previously for the detection of arsenic and tin. The other detection system was a modification of the Perkin-Elmer HGA 400 graphite furnace atomizer. The germanium is reduced by sodium borohydride to germane, stripped from solution by a helium gas stream, and collected in a liquid-nitrogen-cooled trap. It is released by heating rapidly, and enters a modified graphite furnace synchronized to reach the analysis temperature of 2600 degrees C before arrival of the germane peak. The atomic absorption peak is recorded and electronically integrated. The absolute detection limit is 140 pg germanium. The concentration limit of detection is 0.56 ng/liter for a 250 ml sample. (Baker-FRC)
W81-04113

SAMPLE CONTAINERS FOR TRACE ANALYSIS OF DISSOLVED OXYGEN, HYDROGEN, AND CARBON DIOXIDE IN WATER,
Westinghouse Research and Development Center, Pittsburgh, PA.

A. Pebler.
Analytical Chemistry, Vol 53, No 2, p 361-362, February, 1981. 1 Tab, 3 Ref.

Descriptors: *Trace elements, *Analytical methods, *Sampling, Carbon dioxide, Hydrogen, Oxygen, Gases, *Water analysis, *Pollutant identification.

A test program was undertaken to search for less reactive container materials and test pretreatment processes that inactivate container surfaces toward reaction with water and oxygen. It was determined that fresh 304 SS sample containers readily react with dissolved oxygen. As-received low-carbon 304L SS containers are significantly less reactive. New 316 SS and Monel containers showed little or no reaction with oxygen at room temperature. Stainless steel containers are rendered sufficiently passive by passivation in high-temperature alkaline water or dry steam. Dissolved oxygen can be kept in such containers and heated briefly to as high as 150 C without loss. The generation of corrosion hydrogen as well as carbon dioxide and hydrocarbons, presumably by reaction of water with carbides, can simultaneously be eliminated. (Baker-FRC)
W81-04114

PRECONCENTRATION OF TRACE METALS IN ENVIRONMENTAL AND BIOLOGICAL SAMPLES BY CATION EXCHANGE RESIN FILTERS FOR X-RAY SPECTROMETRY,
National Bureau of Standards, Washington, DC. H. Kingston, and P. A. Pella.
Analytical Chemistry, Vol 53, No 2, p 223-227, February, 1981. 3 Fig, 4 Tab, 31 Ref.

Descriptors: *Chesapeake Bay, *Trace elements, *Analytical techniques, Sampling, Cation exchange, Preconcentration, Sea water, Resins, Filters, X-ray spectrometry, *Pollutant identification.

The application of the SA-2 resin-loaded filter technique to the XRF analysis of selected elements in a variety of samples at concentrations as low as 1 ppb is described. Seawater from the Chesapeake Bay is included as one of the samples. The results of the seawater analysis for Ni, Mn, Zn, Cu, and Pb were in agreement with those from other workers to within 5%. The amounts of copper, zinc, nickel, and manganese collected on one filter ranged from 1 to 5 micrograms, which corresponds to a concentration level of 1-5 ppb in the seawater. Iron could not be measured at this level due to the poor reproducibility of the iron blank in the filters even after repeated washings. These results indicate that preconcentration of at least 1 liter of seawater provided sufficiently high elemental mass loading on these filters for quantitation. (Baker-FRC)
W81-04115

APPLICATION OF GAS CHROMATOGRAPHY ON GLASS CAPILLARY COLUMNS TO THE ANALYSIS OF HYDROCARBON POLLUTANTS FROM THE AMOCO CADIZ OIL SPILL,
Laboratoire de Chromatographie, Brest (France). Faculte de Medecine.

F. Berthou, Y. Gourmelon, Y. Dreano, and M. P. Fricourt.
Journal of Chromatography, Vol 203, p 279-292, January, 1981. 8 Fig, 1 Tab, 20 Ref.

Descriptors: *Oil spills, *Chromatography, *Gas chromatography, *Organic compounds, Pollutant identification, Amoco Cadiz, Oil pollution, Analytical techniques, *France, Coasts, Indicators, Oysters, Aquatic life, Marine animals, Aromatic compounds, Persistence.

Hydrocarbons from the Amoco Cadiz oil spill off the Breton Coast in 1978 were effectively analyzed in the environment and in the biota by gas chromatography, varied according to need. High perform-

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ance gas chromatography was the most suitable method for rapid analysis of oil composition for a few weeks after the spill while the oil was fluid and before the bulk of the volatiles evaporated. Trace level analysis of hydrocarbons in oil was improved by using perdeuterated hydrocarbons as internal standards and a glass capillary column. Effective lipid extraction and cleanup procedures were needed. The very persistent dibenzothiophene derivatives (especially the diand trimethyl) were recommended as long-term indicators of pollution. Gas chromatography with flame photometric determination, mass spectrometry, and normal phase high performance liquid chromatography were used in this analysis. (Cassar-FRC)
W81-04125

EVALUATION OF BONDED PHASES FOR THE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN EFFLUENT WATERS.
Esso Petroleum Co. Ltd., Abingdon (England).
R. Amos.
Journal of Chromatography, Vol 204, p 469-478, 1981. 14 Tab, 18 Ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Chromatography, Organic compounds, Aromatic compounds, Pollutant identification, Analytical techniques, Water analysis, *Effluents, *Oil industry, Waste water, *Hydrocarbons.

Polycyclic aromatic hydrocarbons in refinery effluent water were determined by high performance liquid chromatography using 30 different chemically-bonded stationary phases. HC-ODS-Sil-X from Perkin Elmer Co., an octadecyl reversed-phase material, separated all components of interest so that 0.01 micrograms per liter of each polycyclic aromatic hydrocarbon on the WHO and EPA lists could be detected. An additional 5 materials successfully separated a pyrene-benzo(alpha)pyrene mixture in 30 minutes to a resolution of 1.5, using isocratic elution with aqueous acetonitrile as the mobile phase. (Cassar-FRC)
W81-04126

GAS CHROMATOGRAPHIC INVESTIGATION OF RAW WASTEWATER FROM COAL GASIFICATION,
Research Triangle Inst., Research Triangle Park, NC.

S. K. Gangwal.
Journal of Chromatography, Vol 204, p 439-444, 1981. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Gas chromatography, *Polycyclic aromatic hydrocarbons, *Fuels, Coals, Organic compounds, Waste water, *Pollutant identification, Water analysis, Analytical techniques, Chromatography, Synthetic fuels, Industrial wastes, *Coal gasification.

Gas chromatography was used to characterize polycyclic aromatics in raw waste water from a fixed-bed laboratory coal gasification process using bituminous coal and lignite coal. Chromatographic profiles and lists of compounds detected were listed. Concentrations of several polycyclic aromatic hydrocarbons in the raw waste water far exceeded the maximum levels expected to produce no adverse health effects. Two systems were used to quantify the tars: (1) flame ionization detector and flame photometric detector, effective for sulfur heterocyclics and polycyclic aromatics, and (2) flame ionization detector and nitrogen-phosphorus detector, effective for nitrogen heterocyclics and polycyclic aromatics. (Cassar-FRC)
W81-04127

MEASUREMENT OF PLANKTONIC BACTERIAL PRODUCTION IN AN OLIGOTROPHIC LAKE,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
M. J. Jordan, and G. E. Likens.
Limnology and Oceanography, Vol 25, No 4, p 719-732, July, 1980. 6 Fig, 4 Tab, 64 Ref.

Descriptors: *Lakes, *Primary productivity, *Heterotrophic bacteria, Aquatic productivity, Organic carbon, Fluctuations, Seasonal variations, Biomass, Bacteria, Membrane filters, Plankton, Respiration, *Mirror Lake, New Hampshire.

The planktonic heterotrophic bacteria production of Mirror Lake, New Hampshire, was determined by several different techniques from October 1974 to September of 1976. Depending upon organic carbon fluxes and the sum of bacterial bases, production ranged from 3 to 8 g C/sq m/year. These results were in close agreement with the estimate of 6.5 + or - 1.8 obtained by the sulfate method. Differential filtration with Nucleopore filters showed that only 16% of the total sulfate uptake was due to bacteria. Overestimates in production resulted when dark carbon dioxide-carbon uptake by bacteria was taken as 6% of the heterotrophic bacterial production. Of the total autochthonous plus allochthonous organic carbon inputs to Mirror Lake, 11-31% was contributed by the annual carbon flux through planktonic bacteria. Heterotrophic planktonic bacteria doubling times ranged from 1.2 days in September to over 100 days in February. (Geiger-FRC)
W81-04129

RADIOACTIVELY LABELING OF NATURAL ASSEMBLAGES OF BACTERIOPLANKTON FOR USE IN TROPHIC STUDIES,

California Univ., San Diego, La Jolla. Inst. of Marine Resources.

J. T. Hollibaugh, J. A. Fuhrman, and F. Azam.
Limnology and Oceanography, Vol 25, No 1, p 172-181, January, 1980. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Marine bacteria, *Trophic level, Bioindicators, Radiochemical analysis, Plankton, Biomass, Analytical techniques, Tracers.

A study was performed to develop a method that could be used to measure the rates at which the biomass of natural, unattached bacteria is turned over by bacterivores in plankton communities. Tritium-labeled thymidine was employed as a tracer because thymidine, due to its incorporation into DNA, would provide the metabolic conservation required. Tritiated thymidine is available in high specific activity, so that highly labeled bacterial assemblages can be obtained, increasing the sensitivity and precision of the method. This method avoided the problem of loss of label during short term feeding experiments. Highly labeled bacterial allowed the measurement of grazing by microzooplankton with clearance rates as low as 1 microliter/individual/day. (Baker-FRC)
W81-04147

SECCHI DISK AND CHLOROPHYLL,

Washington Univ., Seattle. Dept. of Zoology.

W. T. Edmondson.
Limnology and Oceanography, Vol 25, No 2, p 378-379, March, 1980. 4 Ref.

Descriptors: *Secchi Disks, *Light penetration, *Chlorophyll, *Plankton, *Turbidity, Analytical techniques, Instrumentation, Optical properties, Limnology, Particle size, Eutrophication, Algae, Phytoplankton.

Secchi disk transparency and chlorophyll content are not always related. Correlation is accidental because cell size and chlorophyll content are generally within a limited range. Light attenuation is more closely related to the surface area of particles than to their volume. Deep Secchi disk values have been associated with high chlorophyll values in the presence of high populations of *Anabaena* or *Aphanizomenon*. Nevertheless, the Secchi disk is a useful tool in limnology, particularly in communicating lake quality to the public, which is concerned with transparency, and in measuring visibility of prey to predator. (Cassar-FRC)
W81-04148

PHOSPHATE INTERFERENCE IN THE CADMIUM REDUCTION ANALYSIS OF NITRATE,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.

R. J. Olson.
Limnology and Oceanography, Vol 25, No 4, p 758-760, July, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Separation techniques, *Phosphates, *Seawater, Pollutant identification, *Nitrates, Oxidation, Cadmium, Copper, Nitrite, Optical properties.

Cadmium or cadmium-copper systems are commonly used in the analysis of nitrate in natural water samples. A continuous analysis of filtered surface seawater enriched with 15 micromoles of nitrate with varying additions of phosphate showed that phosphate at 2.5 micromoles decreased the reduction of nitrate by 10% and at 25 micromoles by 40%. This interference depended on the age of the reductors and reagents and was gradual and reversible. Since the interference is difficult to correct for, samples should be diluted to minimize phosphate levels. Testing of the columns periodically for phosphate interference and replacing columns when necessary are also recommended. (Geiger-FRC)
W81-04150

PHYSIOLOGICAL ALTERATIONS OF VEGETATIVE MICROORGANISMS RESULTING FROM CHLORINATION,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.

C. N. Haas, and R. S. Engelbrecht.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1976-1989, July, 1980. 8 Fig, 3 Tab, 45 Ref.

Descriptors: *Microorganisms, *Chlorination, *Water quality, Coliforms, Bacteria, Enteric bacteria, Yeasts, Enteroviruses, Viruses, Measurement techniques, Chlorination, Toxicity, *Bacterial analysis, Water treatment, Bioindicators.

Fermentative yeasts and Group IV atypical acid-fast bacteria have been proposed as new indicators of disinfection efficiency to supplement or replace coliforms in the assessment of the biological health hazard, particularly from enteric viruses. The effects of free available chlorine on physiological processes of representative organisms from the yeast, acid-fast, and coliform groups were determined in chlorine-demand-free systems. After exposure to chlorine, leakage of ultraviolet-absorbing material and total organic carbon from the test organisms was observed. Exposure to chlorine inhibited respiration under certain conditions, altered cellular potassium uptake and retention, and diminished the rate of protein and DNA synthesis. Organism survival after exposure to chlorine was correlated with reversion frequency. Free available chlorine acts at or near the cell membrane, as well as on the cell DNA. It was predicted that the acid-fast and yeast organisms would maintain increased chlorine resistance as compared to coliforms under many circumstances. (Carroll-FRC)
W81-04177

DETERMINATION OF CYANIDES AND THIOCYANATES IN WATER BY HEADSPACE GAS CHROMATOGRAPHY WITH A NITROGEN-PHOSPHORUS DETECTOR,
Naples Univ. (Italy). Chemical Inst.

G. Nota, V. R. Miraglia, and C. Improta.
Journal of Chromatography, Vol 207, No. 1, p 47-54, March 6, 1981. 3 Fig, 7 Tab, 5 Ref.

Descriptors: *Coke oven effluents, *Water analysis, *Cyanide, Thiocyanates, *Pollutant identification, Analytical techniques, Chromatography, Gas chromatography.

A simple method for determination of trace amounts of cyanide and/or thiocyanate has been applied to analysis of coke over water and coke oven waste effluent before discharge into the sea. Thiocyanates area reacted with phosphoric acid and bromine water to form cyanide. After transformation of the cyanide into HCN by acidification, the HCN is removed by the headspace technique, separated by gas chromatography, and selectively detected with a nitrogen-phosphorus detector. The method, which can be easily automated, is accurate

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in the .01 to 100 ppm range. Since cyanide levels in the coke effluent waste waters were on the order of 50-100 ppm, samples were diluted prior to analysis. (Cassar-FRC)
W81-04190

DETERMINATION OF PRIORITY POLLUTANT PHENOLS IN WATER BY HPLC, Alter Scientific, Berkeley, CA.

P. A. Realini.
Journal of Chromatographic Science, Vol 9, No 3, p 124-129, March, 1981. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Pollutant identification, *High pressure liquid chromatography, *Phenols, Separation techniques, Industrial wastes, Pesticides, Water analysis, Waste water analysis, Organic wastes, *Chromatography.

Phenols are often detected in industrial wastes due to their widespread use as intermediates in the production of such products as plastics, pesticides, drugs and dyes. A method for identifying phenolic compounds in water at the nanogram/liter level by high pressure liquid chromatography is described. Eleven standard phenolic compounds were separated using a MicroPak 5 micron C18 column with an acetic acid:water:acetonitrile effluent. A two-step extraction with methylene chloride using a cationic ion-pair reagent was utilized to concentrate the samples, and identification of the compounds was accomplished by dual UV detection. Recoveries for ten of the compounds studied were greater than 90%. Recovery of phenol itself was only 75%. A water sample collected from a canal near an industrial plant was spiked with 4,6-dinitro-o-cresol and carried through the sample procedure. The phenolic compound was detected at both 254 and 280 nanometers, with recoveries of 93%. (Geiger-FRC)
W81-04191

DETERMINATION OF THE AQUATIC HERBICIDE FLURIDONE IN WATER AND HYDROSOIL: EFFECT OF APPLICATION METHOD ON DISSIPATION, Lilly Research Labs., Greenfield, IN. Agricultural Research Div.

S. D. West, and S. J. Parka.
Journal of Agricultural and Food Chemistry, Vol 29, No 2, p 223-226, March-April, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Fluridone, *Fate of pollutants, *Degradation, Pollutant identification, High pressure liquid chromatography, Water analysis, Herbicides, Chromatography, Ponds, Sediments, Separation techniques.

The effect of application technique was investigated in two adjacent ponds, one treated with 0.84 kilograms/ha of fluridone on the surface and the other with the same level of herbicide on the bottom of the pond. The half-life of fluridone in the pond treated on the surface was 21 days, while in the pond treated on the bottom, the half-life of fluridone was 26 days. Similar hydrosol fluridone residue patterns were observed for both ponds, with no detectable residue remaining after 56 days. Fluridone determinations were carried out by reverse-phase high pressure liquid chromatography with UV detection at 254 nanometers. This technique eliminated the need for fluridone bromination for detection by electron capture gas chromatography, while allowing direct injection of filtered samples into the high pressure liquid chromatograph. Some water samples were purified by XAD-2 and alumina column chromatography prior to high-pressure liquid chromatographic analysis. (Geiger-FRC)
W81-04192

THE POTENTIAL OF SATELLITE AND AIRCRAFT REMOTE SENSING TECHNIQUES TO MARINE AND COASTAL POLLUTION MONITORING, Dundee Univ. (Scotland). Tay Estuary Research Center.

For primary bibliographic entry see Field 7B.

W81-04206

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY OF POLYCHLORO-2(CHLOROMETHYL SULPHONAMIDO) DIPHENYL ETHERS AND THEIR IMPURITIES IN THE MOTHPROOFING AGENT, EULAN WA NEW, AND IN WATER, Freshwater Fisheries Lab., Pitlochry (Scotland). D. E. Wells, and S. J. Johnstone.
Journal of Chromatographic Science, Vol 19, No 3, p 137-143, March, 1981. 7 Fig, 5 Tab, 20 Ref.

Descriptors: *Pollutant identification, *High performance liquid chromatography, *Insecticides, Water analysis, Separation techniques, Pesticides, Industrial wastes, Organic wastes, *Chromatography, Hydrogen ion concentration.

The high-performance liquid chromatographic analysis of the active ingredients, polychloro-2(chloromethyl sulphonamido) diphenyl ethers (PCSDs), and the polychloro-2-amino diphenyl ether (PAD) impurities in Eulan WA New is described. Samples of natural waters suspected of containing Eulan WA New were extracted using DC 200-coated polyurethane foam plugs. The extraction procedure was pH-dependent, and the resulting plug extract was cleaned up on a layered acidic and basic alumina column. After elution with solvents of different polarities and acidities, the samples were blown to dryness and reconstituted in methanol for analysis by high performance liquid chromatography. Recoveries of PCSDs from spiked distilled water ranged from 91 to 99%, while those of the PADs ranged from 80 to 116%. The effects of solvent composition, pH, column packing, detector wavelength, and the use of an internal standard on the process are also considered. (Geiger-FRC)
W81-04221

IMPROVED CLEANUP TECHNIQUE FOR ESTIMATION OF ENDOSULFAN RESIDUES FROM FISH TISSUES UNDER TROPICAL CONDITIONS, Nagarjuna Univ., Nagarjunanagar (India). Dept. of Zoology.
D. M. R. Rao.
Journal of the Association of Official Analytical Chemists, Vol 64, No 2, p 340-342, March, 1981. 3 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Endosulfan, *Separation techniques, Pesticides, *Insecticides, Thin layer chromatography, Fish toxins, Column chromatography, Cleanup, Agricultural runoff, Organic solvents.

The broad spectrum insecticide endosulfan has been used extensively on crops in recent years, resulting in the contamination of aquatic systems. A cleanup method is described for the determination of endosulfan residues in the tissues of tropical fish by thin layer chromatography. After liquid-liquid extraction with a hexane-acetonitrile system, the hexane extract is added to a partially inactivated Florisil chromatographic column. Column eluates are separated and concentrated before analysis by thin layer chromatography. When the colorimetric method of Maitlen et al. (1963) is utilized, the minimum detectable limit for each endosulfan isomer in fish tissues is 5 micrograms. Using the present solvent system, the two isomers present in technical endosulfan may be separated and evaluated individually for toxic effects to fish. (Geiger-FRC)
W81-04225

SUCCESSFUL LABORATORY ANALYSIS, J. D. Leach.
Southwest and Texas Water Works Journal, Vol 62, No 11, p 12-13, February, 1981.

Descriptors: *Quality control, *Water analysis, Feces, Coliforms, Bacteria, Sludge, Biochemical oxygen demand, Chlorine, Acidity, Dissolved oxygen, Sampling, Laboratories, Water treatment facilities.

Some ideas that may help maintain quality control both in the waste water laboratory and in the plant are presented. Sampling is the most important

factor in laboratory quality control. Consistent sampling, though difficult to accomplish when samples are taken by operators on shiftwork, is essential. Various methods may be used for determining pH and chlorine residual factors. One of the largest expenses encountered in activated sludge systems is the maintenance of adequate dissolved oxygen in aeration tanks and digesters. Analysis of solids is also dependent to a great extent on good sampling techniques. Discussion is also given to BOD determinations, fecal coliform counts, and microscopic analyses of sludge. The use of qualified personnel to carry out the procedures correctly is essential. (Baker-FRC)
W81-04234

MONITORING DISCHARGES, Louisiana Tech Univ., Ruston.
For primary bibliographic entry see Field 9A.
W81-04243

PRECONCENTRATION OF TRACE METAL IONS BY COMBINED COMPLEXATION-ANION EXCHANGE, PART 2. COBALT, ZINC, CADMIUM, AND LEAD WITH 8-HYDROXY-QUINOLINE-5-SULFONIC ACID, Wisconsin Univ.-Oshkosh, Dept of Chemistry. D. G. Berge, and J. E. Going.
Analytica Chimica Acta, Vol 123, p 19-24, 1981. 4 Fig, 24 Ref.

Descriptors: *Metals, *Trace elements, *Ion exchange, Analytical techniques, *Pollutant identification, Cobalt, Zinc, Cadmium, Lead, Metals, Heavy metals, Anion exchange.

Trace metals may be determined by precomplexing with 8-hydroxyquinoline-5-sulfonic acid and concentrating on anion-exchange resins. At optimum conditions (pH 8, ligand/metal ratio 100:1, sample volume 250 ml, sample concentration 0.1 to 1 micro-mole) the divalent ions Co, Zn, Cd, and Pb were all retained quantitatively on the column. Elution was complete with 11 ml or less of 2 ml nitric acid for Zn, Cd, and Pb and 12 M HCl and 2 M nitric acid for Co. Concentration factors were 25 for the 250 ml sample and 100 for the 1 liter sample. Ligand-loaded resins allowed greater than 99% recovery for all metals. These are useful in field studies because concentrated metals may be left on the columns up to 7 days without reducing recovery. (Cassar-FRC)
W81-04248

THE STRUCTURE AND WORK OF THE DOE/NWC STANDING COMMITTEE OF ANALYSTS, Department of the Environment, London (England). Water Pollution Div. T. A. Dick.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 1, p 88-93, January, 1981. Appendix.

Descriptors: *Organizations, *Analytical techniques, National Water Council, *United Kingdom, Standing Committee of Analysts, *Water quality, *Water analysis.

The Standing Committee of Analysts, one of eight joint technical committees of the Department of the environment and the National Water Council (Great Britain), is primarily concerned with publishing recommended analytical methods for examination of water quality. There are nine working groups: General Principles of Sampling and Results, Instrumentation and On-line Analysis, Empirical and Physical Methods, Metals and Metalloids, General Non-metallic Substances, Organic Impurities, Biological Methods, Sludge and Other Solids Analysis, and Radiochemical Methods. (Cassar-FRC)
W81-04274

5B. Sources Of Pollution

URBAN SNOWMELT-CHARACTERISTICS AND TREATMENT,

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

Colorado Univ., at Boulder. Dept of Civil, Environmental, and Architectural Engineering. E. R. Bennett, K. D. Linstedt, V. Nilsgard, G. M. Battaglia, and F. W. Pontius. Journal of the Water Pollution Control Federation, Vol. 53, No. 1, p119-125, January, 1981. 1 Fig, 8 Tab, 10 Ref. OWRT-A-028-COLO(5).

Descriptors: *Runoff, *Snowmelt, *Urban runoff, Storm runoff, Surface runoff, Storm water, Coagulation, Path of pollutants, Rainfall, Precipitation, *Waste water treatment, Chemical oxygen demand, Suspended solids, Sedimentation, Filtration, Water pollution sources, Pollutant levels, Nitrates, Phosphates.

The pollutant levels in snowmelt and rainfall runoff were determined in 2 residential areas in Boulder, Colorado: A, a high density area with a small commercial area, apartments, rooming houses and heavy vehicular traffic, and B, a low density area with single family homes and very light traffic. High density Area A runoff had higher pollutant concentrations than rainfall runoff. Suspended solids and COD loading were half that for rainfall; phosphorus, total Kjeldahl nitrogen and nitrates, 1/4 that of rainfall. Oil and grease levels from undersides of vehicles were higher in snowfall melt. Experimental treatment of the stormwater discharges showed that plain sedimentation was much less effective for snowmelt runoff than for rainfall runoff because particulates in the snowmelt were much more colloidal. However, chemical treatment and filtration through 30 mesh sand were quite effective. Optimum chemical doses were alum, 50 mg per liter; ferric chloride, 50 mg per liter; and lime, 100 per liter. (Cassar-FRC) W81-03952

TRANSPORT OF RESISTANCE-LABELED *ESCHERICHIA COLI* STRAINS THROUGH A TRANSITION BETWEEN TWO SOILS IN A TOPOGRAPHIC SEQUENCE, Oregon State Univ., Corvallis. Dept. of Soil Science. E. L. McCoy, and C. Hagedorn.

Journal of Environmental Quality, Vol 9, No 4, p 686-692, October/December, 1980. 4 Fig, 1 Tab, 18 Ref. OWRT-A-039-ORE(4), 14-34-0001-7078.

Descriptors: *E. coli, *Runoff, Drainage, Hydrologic data, Groundwater, Mechanical properties, Pollution, Drainage systems, Soil profiles, Computer models, Translocation.

Pathways and characteristics of bacterial transport through saturated soils were investigated. Resistance-labeled *Escherichia coli* strains were introduced into the soil through injection lines at depths corresponding to A, B, and C horizons of the soil profile. Computer generated three dimensional poli diagrams were constructed to display the translocation of the bacteria through the experimental site. At the first sampling row downslope bacterial translocation patterns varied with the depth of injection. However, as the bacteria penetrated into the transition zone, flow pathways converged, and differences due to injection depth disappeared. As the downslope flow of water was directed upward in the soil profile by hydraulic gradients and a restrictive clay layer, a transition from mainly matrix flow to 'pipe' flow was noted. Translatory pipe flow had a significant influence through this transition, with large volumes of the water passing downslope being intercepted and conducted by these channels. These findings demonstrate the large influence of pipe flows in draining a concave slope, supporting previous findings and indicating that an overland low network is interconnected with a substantial subsurface pipe network that penetrates further upslope and contributes large volumes of rapidly flowing water. (Baker-FRC) W81-03956

SOURCES OF POLLUTANTS TO THE GREAT LAKES, International Joint Commission, Windsor (Ontario), Great Lakes Regional Office. W. R. Drynan.

Available from the National Technical Information

Service, Springfield, VA 22161 as PB81-276646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sep 16-17, 1980, Chicago, IL. EPA Report EPA-905/9-80-009, September, 1980. p 63-73, 8 Tab, 13 Ref.

Descriptors: *Water pollution sources, *Great Lakes, *Nonpoint pollution sources, Municipal wastes, Industrial wastes, Urban runoff, Agricultural runoff, Atmosphere, Phosphorus, Eutrophication, Metals, Heavy metals, Organic compounds, Erosion, Monitoring, Water pollution control.

Pollutants are introduced to the Great Lakes principally through municipal and industrial point source wastewater discharges, atmospheric deposition, urban and agricultural land runoff, and in the lower lakes, interlake transfer. Once phosphorus had been identified as the major nutrient implicated in eutrophication, with municipal wastewater as its principal source, measures were taken to reduce it. Attention was transferred to problems caused by heavy metals and toxic organics. Municipal and industrial sources of these pollutants are monitored but little information is available on loadings from combined sewer overflows. Some information is available on loadings from the non-point sources urban and agricultural runoff, streambank and shoreline erosion. The atmosphere is a very significant source of PCB's and lead, and a significant source of other organics, total phosphorus, and metals. It is the major source of lead in all the lakes. Other potential pollutant sources are spills, dredging and disposal of dredged material, and resource recovery operations. Improvements are needed in sampling and monitoring programs for the tributary and atmospheric inputs. (Brantley-SRC) W81-03967

THE VARIETY OF ON-SITE TREATMENT SYSTEM FAILURE.

Environmental Protection Agency, Chicago, IL. Water Div.

A. E. Krause.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminars on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 203-206.

Descriptors: *Waste water treatment, *Water pollution sources, *Water quality, Aerial photography, Groundwater pollution, Soil properties, Clogging, Aquifers, Waste water pollution, Overland flow, Nitrogen, Phosphorus, Bacteria, Viruses, Treatment system failure.

Although there are numerous and very real problems of on-site system failure, its presumed but unproven presence has been the justification for a wide variety of centralized treatment systems. New sensing mechanisms and a variety of on-site studies allow a broader and deeper understanding of this phenomenon. On-site treatment system failures may be surface failure and overload flows, groundwater failures or elective failures. Surface failures are usually associated with clogging mat formation, and may be complicated by tight soils or hydraulic system overload. Groundwater failures are most common on soil of medium to high porosity, and are not usually associated with clogging mat formation. Since the groundwater effluent plume often moves along the surface of the aquifer, its effects are greatly complicated by groundwater flow. Special situation or elective failures include direct tile drainage, straight pipes to streams and midnight pumpout of holding tanks. It also includes the contamination of an entire aquifer by excessive on-site system loading. Nitrates are one of the most significant pollutants in cases of well contamination. Phosphorus has little direct public health impact, but is well known as a major factor in lake and stream enrichment. Bacteria and viruses usually enter bodies of water through overload flow. Failure sensing methods include: interview and inspection; aerial photogra-

phy, septic leachate detectors, and groundwater flow meters. Using the new sensing approaches it is now possible and cost-effective to determine which of a group of on-site treatment systems may be causing water quality problems, and if an areawide problem exists. (Moore-SRC) W81-03975

MILL CREEK PILOT WATERSHED STUDY ON PESTICIDE FATE IN AN ORCHARD ECO-SYSTEM: DEVELOPMENT AND PRESENTATION OF THE EXPERIMENTAL DATA BASE, Michigan State Univ., East Lansing. Pesticide Research Center.

M. J. Zabik, J. J. Jenkins, R. Kon, E. Geissel, and E. Goodman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 207-223, 3 Fig, 8 Tab.

Descriptors: *Fate of pollutants, *Pesticide residues, *Orchards, *Organophosphorus pesticides *Agricultural runoff, Sediment transport, Model studies, Agricultural watershed, Apples, Mill Creek watershed, Michigan.

Mill Creek represents a watershed typical of the large fruit growing region of southwestern lower Michigan. Since fruit orchard farming utilizes some of the most intensive pesticide application rates of any agricultural practices in the Great Lakes Basin, pesticide transport processes are investigated, to determine the relative amount of pesticide transported on suspended solids and in solution. After an initial survey of the entire watershed, studies were concentrated on the agricultural portion of the watershed. Data were developed on the pesticide exports in event flows and non-event flows, and for both dissolved pesticides and filtered pesticides. To develop a methodology for modeling the ecosystem effects of alternative pesticides, a deciduous orchard ecosystem was chosen. The organophosphate insecticide azinphosmethyl was chosen as an example as it is one of the most widely used and potentially toxic compounds used in orchards. An abandoned apple orchard was converted into an experimental unit to gather data on azinphosmethyl dynamics under a regime of periodic sprays. Examination of residues reaching each stratum of the orchard showed the majority of the dislodgable residues are distributed to the trees and grass. Litter and soil residue levels are roughly 10 times lower than tree leaf residues. Runoff studies indicate a small contribution to the loss of azinphosmethyl from the orchard from this route. Vertical pesticide movement among strata occurs under both rainfall and no-rainfall conditions. (Moore-SRC) W81-03976

UPSTREAM POINT SOURCE PHOSPHORUS INPUTS AND EFFECTS, Heidelberg Coll., Tiffin, OH. Water Quality Lab. D. B. Baker.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 227-239, 3 Fig, 6 Tab, 15 Ref.

Descriptors: *Phosphorus removal, *Water pollution control, *Sediments, *Particulate matter, Non-point pollution sources, Upstream, Water quality management, Waste water treatment, Cost-benefit analysis, Pollution load, *Lake Erie basin, Path of pollutants.

The management of phosphorus within the Lake Erie Basin is one area in which opportunities for integrated point/nonpoint source management exist. In the Sandusky River Basin, most of the phosphorus entering the river from upstream point

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

sources becomes tied up within the river sediments. Its eventual delivery to the lake is in the form of particulate rather than soluble phosphorus. The delivery ratio of this phosphorus to the lake is probably less than 100%. Evidence of ambient stream water quality problems associated with point source phosphorus loading is lacking. The nonpoint source phosphorus loading component is so large and variable that the effects of further point source control programs in reducing phosphorus output from the basin could not directly be measured. Because of in-stream processing of upstream point source phosphorus, the impacts of this phosphorus on lake water quality are likely to be quite different than for direct discharge to the lake. Consequently different requirements for phosphorus removal should be considered for upstream point sources. The water quality benefits that could be achieved through diverting portions of funds needed to operate phosphorus removal programs to support nonpoint source implementation or flow augmentation programs should also be considered. (Moore-SRC)

W81-03977

SEDIMENT AND PHOSPHORUS TRANSPORT,

Army Engineer District, Buffalo, NY.
S. M. Yaksich, D. A. McElroy, and J. R. Adams.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September, 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September 1980, p 241-277, 13 Fig, 4 Tab, 14 Ref.

Descriptors: *Phosphorus, *Sediment transport, *Monitoring, *Rivers, High flow, Low flow, Water pollution sources, Particulates, Sediment load, Suspended solids, Sampling, Diurnal distribution, Watersheds.

Observed river transport characteristics are discussed in relation to transport mechanisms of sediments and total phosphorus. Event response rivers are those in which suspended sediment (SS) and total phosphorus (TP) concentrations increase with increasing flow and stable response rivers are those in which they do not. In event response river, the bulk of the phosphorus is transported by the sediment but the TP/SS ratio varies considerably. Different patterns of concentration versus flow exist between river basins with no upstream point sources, point sources immediately upstream, and point sources considerably upstream. Soluble and particulate phosphorus which enters a river during low flow is quickly removed from the water column and resuspended and transported as particulate phosphorus during high flow. SS and TP travel a finite distance, and the probability of it travelling a certain distance can be calculated. This probability will change and vary between events and rivers. High flow events must be sampled in event response rivers or SS and TP fluxes will be underestimated by 15-30%. Considerable diurnal variation can exist during low flow at stations below point sources. The mean annual load is a more representative calculation of SS and TP than the annual load. Unit area loads vary between river basins. Caution should be exercised in using unit area loads measured for other watersheds. Fluxes for stable response rivers can be estimated with fixed interval sampling programs, while event response rivers require sampling during two or three of the high flow events, and during low flow periods. (Brambley-SRC)

W81-03978

BIOAVAILABILITY OF PHOSPHORUS SOURCES TO LAKES,

Ohio State Univ., Columbus. Dept. of Agronomy. T. J. Logan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September, 6-17, 1980, Chicago Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September 1980, p 241-277, 13 Fig, 4 Tab, 14 Ref.

mental Protection Agency Report EPA-905/9-80-009, September 1980, p 279-292, 3 Tab, 42 Ref.

Descriptors: *Phosphorus, *Eutrophication, *Sediments, *Algal growth, Bioassay, Adsorption, *Great Lakes, Pollution load, Water pollution control, Sediment load, Shallow water, Deep water, Nonpoint pollution sources, Suspended sediments, Nutrients.

The bioassay procedures used to measure available phosphorus, studies which correlated biological availability with chemical extraction, and estimates of bioavailability of Great Lakes sediments and waters are discussed with reference to point and nonpoint source phosphorus management. Bioassays have shown that phosphorus availability from sediments for algal growth correlates with the NaOH extractable phosphorus, but that the release rates are slow. This phosphorus is adsorbed by metal hydroxides, iron, aluminum and calcium compounds. Availability of phosphorus in sediments entering the Great Lakes ranges from 10-50% of the total particulate phosphorus, with an average of 20%. About 50% of precipitation phosphorus and 100% of soluble inorganic phosphorus can be considered available. The target annual load of phosphorus entering Lake Erie is 11,000 metric tons. This target can be achieved by maximum adoption of conservation tillage by farmers, which will reduce the sediment load, but the available phosphorus would be reduced only 9-16%. To reduce the available phosphorus point source phosphorus pollution must be reduced, since 75% of this phosphorus is available. This latter source is more important for deep lakes, with little resuspension of sediments, than for shallow lakes where resuspended sediments are a continuing source of phosphorus. (Brambley-SRC)

W81-03979

NONPOINT SOURCE POLLUTION IN URBAN AREAS,

Wisconsin Dept. of Natural Resources, Madison. Bureau of Water Quality.

J. Baumann, A. Domanik, and J. Konrad. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September, 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September 1980, p 309-322, 2 Tab.

Descriptors: *Urban runoff, *Nonpoint pollution sources, *Sediments, *Nutrients Water pollution control, Phosphorus, Heavy metals, Toxicity, Drainage patterns, Urban planning, Land use, Sediment control, Construction.

Urban runoff is a significant nonpoint pollution source (NPS). Four studies of its impact in Wisconsin are reviewed. The major NPS pollutants are sediments, nutrients and heavy metals, with some problems of BOD, fecal coliform and chlorides. Two thirds of the phosphorus load in the Menomonee River is from NPS, and urban runoff is suggested to contain twice the phosphorus of rural runoff, acre for acre. Sediment is a pollution problem by itself, and also because of the nutrients, BOD, and toxic substances, particularly heavy metals, associated with it. Urban runoff pollution is increased because of increased impervious surfaces, altered drainage patterns and decreased groundwater flow in low flow periods. Developing urban areas are major sources of sediment, due to disturbed vegetative cover and exposed soils, while developed areas are major source of heavy metals. A control strategy should consider: control of sediment, especially the small particles with adsorbed pollutants; land uses generating the most pollution; increasing infiltration and reducing overland flow; and preventing the original pollution. Sediment control practices in all phases of residential construction, backed up by legal sanctions, are available to reduce sediment loads, but in developed urban areas there are fewer options for NPS control. (Brambley-SRC)

W81-03982

BIOTIC IMPACT OF ORGANIC AND INORGANIC SEDIMENTS,

Environmental Protection Agency, Chicago, IL. Region V.

For primary bibliographic entry see Field 2J.

W81-03985

EPA REGULATORY/RESEARCH PROGRAM, Environmental Protection Agency, Denver, CO. Region.

T. Thoem, A. Christianson, E. Harris, E. Bates, and W. McCarthy.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, Colorado. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980, p 12-21, 6 Fig.

Descriptors: *Oil shale, *Mine wastes, *Environmental effects, *Legislation, *Environmental protection, Regional development, Pollution control, Planning, Water pollution sources, Water resources development.

Mining and conversion of oil shale will degrade air quality, consume precious water resources, create solid and hazardous wastes to be disposed of properly, create significant population growth in a predominantly rural setting, and may degrade surface and/or groundwater quality. The Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act provide the primary legislative framework for regulations which control these environmental impacts. The EPA administers these laws, and ten of its laboratories conduct or contract oil shale-related environmental studies. The specific objectives of the EPA oil Shale Program are to support the regulatory goals of the agency and to ensure that any oil shale industry to be developed will be accomplished in the most environmentally acceptable manner that is reasonably possible. The document 'Pollution Control Guidance for Oil Shale Development' will attempt to capitalize the potential environmental impacts of an oil shale facility / industry. The EPA is not receptive to nor supportive of any plans or incentives which would encourage the rapid development of a large industry because of the environmental uncertainties. (Brambley-SRC)

W81-03987

APPLICATIONS OF DISSOLVED ORGANIC CARBON FRACTIONATION ANALYSIS TO THE CHARACTERIZATION OF OIL SHALE PROCESSING WATERS.

Geological Survey, Denver, CO.

For primary bibliographic entry see Field 5A.

W81-03992

SAMPLING STRATEGIES IN GROUNDWATER TRANSPORT AND FATE STUDIES FOR IN SITU OIL SHALE RETORTING.

California Univ., Livermore. Lawrence Livermore Lab.

K. D. Pimentel, D. H. Stuermer, and M. M. Moody.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, CO. EPA Report EPA-600/9-80-022, June, 1980, p 286-302, 2 Fig, 50 Ref, W-7405-ENG-48.

Descriptors: *Oil shale, *Groundwater pollution, *Sampling, *Monitoring, *Design criteria, Water pollution sources, Pollutants, Computer models, Solute transport, Stochastic hydrology, Data acquisition, Economics.

This paper proposes a new concept for designing groundwater monitoring to assess the effects of in situ oil shale retorting. The concept includes new ways to characterize pollution source terms; build and calibrate hydrological models; estimate stochastic systems; and optimize measurement system

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Sources Of Pollution—Group 5B

designs. The major constituents in leachate of spent shale include: Na, K, Cl, F, ammonia, bicarbonate, sulfate, and total dissolved soils, and significant amounts of the toxic elements As, B, Hg, Mo, Ni, Pb, and Se. There are a number of computer implementations of methods to solve the equations of groundwater mass and solute transport, although they may be too simple to simulate adequately the complex hydrogeology. State and parameter techniques estimating stochastic dynamic systems have evolved to a high degree of sophistication and are beginning to be applied to optimal monitoring system design. Results from experimental design theory will yield information to assess designs of an optimal monitoring system. The changes in groundwater resulting from in situ restoration require different monitoring designs for the different phases, and it is considered that quantitative, analytical approaches to them will produce the most statistically significant data for the cost. (Brambley-SRC)
W81-03993

FATE AND EFFECTS OF PARTICULATES DISCHARGED BY COMBINED SEWERS AND STORM DRAINS.

Municipality of Metropolitan Seattle, WA. Water Quality Div.
R. D. Tomlinson, B. N. Bebee, A. A. Heyward, S. G. Munger, and R. G. Swartz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118390. Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-111, August 1980. 183 p, 45 Fig, 28 Tab, 104 Ref, 1 Append.

Descriptors: *Combined sewers, *Storm drains, *Storm runoff, *Particulate matter, *Water pollution, Eutrophication, Viruses, Copper, Lead, Chlorinated hydrocarbons, Organic carbon, Construction, Benthos, Oligochaetes, Urban drainage, Marine environment, Estuarine environment, Enteroviruses, *Seattle area, Washington.

The distribution and biological impacts of discharged particulates were evaluated for selected combined sewer outfalls (CSOs) and storm drains (SDs) in the Seattle, Washington region. Intensive studies were done on one CSO and one SD discharging into Lake Washington and having residential drainage basins of comparable size and incident rainfall. The mean storm discharge concentrations of suspended solids and most particulate contaminants were greater for the CSO than for the SD. Due to the SD's greater discharge volume, its annual particulate discharge load was greater for Cu, Pb, organic carbon and chlorinated hydrocarbons. Human enteric viruses were also detected in the CSO discharge, but were not found in storm drainage or in any near-overfall sediments. Light transmission measurements of discharge plumes identified extensive additional inputs from neighboring CSOs, SDs and construction sites. Oligochaete numbers and biomass were found to be substantially enhanced near two CSOs and two SDs studied in Lake Washington. Near-overfall depletion of other taxons at both CSOs and SDs also provided evidence of effluent toxicity and/or substrate alterations. Impacts of dischargers on the freshwater benthos raised concern relative to the feeding success of sportfish. On the basis of six different biological indicators sensitive to water and sediment quality, the nearshore area within 150 m of a marine CSO was characterized as polluted. (Moore-SRC).
W81-04003

ADSORPTION, MOVEMENT, AND BIOLOGICAL DEGRADATION OF LARGE CONCENTRATIONS OF SELECTED PESTICIDES IN SOILS,

Florida Univ., Gainesville. Dept. of Soil Science. J. M. Davidson, P. S. C. Rao, L. T. Ou, W. B. Wheeler, and D. F. Rothwell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-11056. Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-124, August 1980. 122 p, 28 Fig, 27 Tab, 68 Ref, 1 Append.

Descriptors: *Pesticides, *Pesticide residues, *Soil types, *Groundwater, Water pollution prevention, Metabolism, Adsorption, Microbial degradation, Waste disposal, Atrazine, Methyl parathion, Terbacil, Trifluralin, 2,4-D, Path of pollutants.

Because of the importance of soil in biologically reducing the quantity and retarding the rate of pollutant movement into groundwater, this laboratory study was initiated to evaluate the adsorption, mobility, and degradation of large concentrations of the pesticides atrazine, methyl parathion, terbacil, trifluralin, and 2,4-D in soils representing four major soil orders in the United States. Solution concentrations ranged from zero to the aqueous solubility limit for each pesticide. The mobility of each pesticide increased as its concentration in the soil solution phase increased. These results were in agreement with the adsorption isotherm data. Pesticide degradation rates and soil microbial populations generally declined as the pesticide concentration in soil increased; however, some soils were able to degrade a pesticide at all concentrations studied, while others remained essentially sterile throughout the incubation period (50 to 80 days). As shown by measurements of C14 carbon dioxide evolution, total carbon dioxide evolution was not always a good indication of pesticide degradation. Several pesticide metabolites were formed and identified. Bound residues of trifluralin and atrazine at the end of the incubation period appeared to be related to types of metabolites formed. The observed increase in pesticide mobility for large pesticide concentrations in the soil invalidates, in many cases, the usefulness of the existing low concentration data base for designing pesticide waste disposal sites. (Author's abstract).
W81-04010

DELTA WATER QUALITY CONDITIONS-IMPLEMENTATION OF WATER QUALITY STANDARDS OF DECISION 1485, CALENDAR YEAR 1979.

California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5A.
W81-04027

MONITORING OF POLLUTANTS IN WASTE WATER, SEWAGE, AND SEDIMENT,

Hawaii Univ., Honolulu. Water Resources Research Center.

For primary bibliographic entry see Field 5A.
W81-04030

AQUATIC MACROINVERTEBRATE RESPONSE TO FORESTRY ACTIVITIES AND WATER QUALITY IN THE OKANOGAN NATIONAL FOREST, WASHINGTON,

A. G. Hoffman.
M.S. Thesis, 1980. 89 p, 15 Fig, 18 Tab, 94 Ref, 8 Append.

Descriptors: *Washington, *Water quality standards, *Macroinvertebrates, *Bacterial analysis, Water analysis, *Forest hydrology, On-site data collections, Water quality, Hydrologic data collections, Microinvertebrates, Contamination, Coliforms, Aquatic fauna, Forestry, Forest, Watersheds, North Cascade mountains, Cattle range.

This investigation studied the water quality of streams on the eastern slope of the North Cascade mountains to determine if forestry, range, and recreational activities have any effect on the forest's water quality, and evaluated the aquatic macroinvertebrate populations of the streams and their differences in relation to variances in water quality and activity. Although the Okanogan Highlands contain the most extensively forested areas of ponderosa pine timber in the state, species composition and distribution of aquatic macroinvertebrates were indicative of high-quality waters. The few exceptions were due to natural phenomena, such as high temperatures. While the water quality was excellent, some deterioration was found to be caused by cattle range activity, as indicated by bacterial contamination and increased nutrient concentrations, particularly in Boulder and Beaver

Creeks. The study network consisted of 13 sites in six stream drainages within the Methow River Basin. Two drainages supported extensive range activity during the sampling period. Factors analyzed weekly or bi-weekly in addition to macroinvertebrate populations were dissolved oxygen, alkalinity, specific conductance, pH, temperature, total and fecal coliforms, fecal streptococcus, discharge, sediment composition, total phosphorus, orthophosphate, total Kjeldahl nitrogen, nitrate-nitrogen, ammonia, dissolved metals, and invertebrates. (Garrison-Omniplan)
W81-04031

CADMIUM IN THE SOUTHERN BASIN OF LAKE MICHIGAN,

Argonne National Lab, IL.
J. Muhihauer, and G. T. Tissue.
Water, Air, and Soil Pollution, Vol 15, No 1, p 45-59, 1981. 2 Fig, 6 Tab, 47 Ref.

Descriptors: *Cadmium, *Lake Michigan, *Water analysis, Metals, Air pollution, Water pollution sources, Path of pollutants, Mathematical models, Sediments, Aquatic life, Precipitation, Rainfall.

A preliminary mass balance for cadmium was determined for Lake Michigan, southern basin, which covers an area of 18,000 sq km. The overall input rate of Cd exceeds the estimated loss rate by a factor of 2.3. Sources of Cd input in tons per year are as follows: rain, 4.3 (40.1%); dry deposition, 2.2 (20.8%); erosion, 1.0 (9.4%); and tributaries, 3.1 (29.2%), for a total of 10.6 tons. Sedimentation is the major (93%) sink in the system, 3.8 tons per year, with outflow of water at a Cd concentration of 20 ng per liter eliminating 0.28 tons per year or 6.9%. Cd levels were projected by mathematical model. If the input rate increases more rapidly than 3% per year, the EPA's standard for protection of aquatic life, 880 ng per liter for waters of Lake Michigan's hardness, will be exceeded in 100 years. (Cassar-FRC)
W81-04061

GEOCHEMISTRY OF MOLYBDENUM IN SOME STREAM SEDIMENTS AND WATERS,

Colorado Univ. at Boulder. Dept. of Geological Sciences.

D. S. Kaback, and D. D. Runnels.

Geochimica et Cosmochimica Acta, Vol 44, No 3, p 447-456, 1980. 3 Fig, 4 Tab, 40 Ref.

Descriptors: *Molybdenum, *Sediments, *Geochemistry, *Tennille Creek, *Colorado, Computer models, Heavy metals, Streams, Mining, Chemical processes, Metal-finishing wastes, Industrial wastes.

Sediments and waters were collected along Tennille Creek and the lower Blue River downstream from a large molybdenum deposit at Climax, Colorado. Very high concentrations of Mo were found in these samples. While similar concentrations have been noted below other smaller deposits of Mo, the great length of the highly anomalous dispersion train below Climax is unusual, extending for over 80 km downstream. The extreme length of the dispersion train suggests that it has resulted from the mining and milling activities at Climax. The chemical form and occurrence of Mo in Tennille Creek are remarkably similar to the form of Mo in stream sediments below two other natural areas of Mo mineralization in Colorado which have remained undisturbed. It is suggested that mining and milling of Mo at Climax have influenced the magnitude of the dispersion but have not changed the basic physical and chemical processes. The form of Mo in the sediments of Tennille Creek is molybdate anion, adsorbed and incorporated into amorphous Fe oxyhydroxide. (Baker-FRC)
W81-04065

DELIVERY OF TRANSURANIC ELEMENTS BY RAIN TO THE MEDITERRANEAN SEA,

International Lab. of Marine Radioactivity, Monte Carlo (Monaco). Oceanographic Museum.

M. Thein, S. Ballestra, A. Yamato, and R. Fukai.

Geochimica et Cosmochimica Acta, Vol 44, No 8, p 1091-1097, 1980. 3 Fig, 2 Tab, 27 Ref.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

Descriptors: *Radioactive isotopes, *Geochemistry, Seawater, *Fallout, Rain, *Mediterranean Sea, Deposition, Path of pollutants, Precipitation, Cesium, Plutonium, Americium, Chemistry of precipitation.

Samples of rain water were collected at Monaco during 1978-79 and analyzed for concentrations of Pu-238, Pu-239+240, Am-241, and Cs-137. The annual deliveries of the radionuclides to the Mediterranean Sea area were calculated from these samples to be 0.18, 8.1, 0.58, and 351 pCi/m sq, respectively. The upper limits of the mean residence time of these radionuclides in the mixed layer were calculated to be about 12.3 years for Pu-239+240 and 2.9 yr for Am-241. The annual activity ratio for Pu-238/Pu-239+240 was 0.022; for Am-241/Pu-239+240, 0.072; and for Pu-239+240/Cs-137, 0.023. The Pu-238/Pu-239+240 and Pu-239+240/Cs-137 activity ratios vary within relatively narrow ranges with time, while a much larger variation was noted for the Am-241/Pu-239+240 activity ratio. The cause of this larger variation in the latter case may have been due to the difference in the mean age of fallout brought down in different seasons. (Baker-FRC)

W81-04066

CHRONOLOGICAL VARIATIONS IN CONCENTRATIONS AND ISOTOPIC COMPOSITIONS OF ANTHROPOGENIC ATMOSPHERIC LEAD IN SEDIMENTS OF A REMOTE SUB-ALPINE POND,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
For primary bibliographic entry see Field 2H.

W81-04068

POLYCYCLIC AROMATIC HYDROCARBONS IN RECENT LAKE SEDIMENTS - I. COMPOUNDS HAVING ANTHROPOGENIC ORIGINS,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W81-04102

POLYCYCLIC AROMATIC HYDROCARBONS IN RECENT LAKE SEDIMENTS - II. COMPOUNDS DERIVED FROM BIOGENIC PRECURSORS DURING EARLY DIAGENESIS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
For primary bibliographic entry see Field 2H.
W81-04103

SULPHUR ISOTOPE RATIOS IN WATER, AIR, SOIL AND VEGETATION NEAR TEEPEE CREEK GAS PLANT, ALBERTA,
Calgary Univ. (Alberta). Dept. of Physics.
H. R. Krouse, and J. W. Case.
Water, Air, and Soil Pollution, Vol 15, No 1, p 11-28, 1981. 8 Fig, 7 Tab, 8 Ref.

Descriptors: *Sulfur, *Water pollution sources, *Air pollution, Radioisotopes. Baseline studies, Soil contamination, Analytical techniques, Pollutant identification, Environmental effects, Gases, Teepee Creek, *Alberta, Canada.

Environmental assessments of sulfur concentration near the Teepee Creek gas plant, Alberta, using sulfur isotope ratios indicated that the plant was not the major source of sulfur in the area. Stack gas samples were greatly enriched in S34, but soil and vegetation were S34 depleted. Surface waters had sulfate concentrations of less than 1 ppm. Some well waters had much higher sulfate concentrations, but not higher S34 levels. Although atmospheric SO₂ was slightly enriched in S34, concentrations did not correlate with the low levels (all less than Alberta's 30 micrograms SO₂ per cu meter standards) of emissions from the gas processing plant. There is no evidence that pH of soil has been lowered as a result of SO₂ emission from the plant. Instead, pH changes were related to the nature of the soil. Likewise, vegetation S34 reflected mineral composition of the soil rather than an effect of the gas plant emissions. (Cassar-FRC)

W81-04108

MODELING SALT TRANSPORT IN IRRIGATED SOILS,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
J. E. Ayars, D. B. McWhorter, and G. V. Skogerboe.
Ecological Modelling, Vol 11, No 4, p 265-290, February, 1981. 11 Fig, 3 Tab, 17 Ref.

Descriptors: *Model studies, *Dissolved solids, *Irrigated land, Colorado River Basin. Saline soils, Soil chemistry, Infiltration, Soil water movement, Calcium compounds, *Path of pollutants, Hydraulic conductivity, Leaching, Soil moisture, Soil profiles, Diffusivity, Soil leaching.

A salt transport model developed by Dutt et al. (1972) and subsequently modified in 1976 determined that the salt concentration of leachate at the bottom of the soil profile is independent of the volume of leachate. Field data (infiltration data, soil water content profiles, and soil water storage change data) collected in the Grand Valley, Colorado, was used to calibrate and test the model. The Dutt model was varied during the course of study with respect to hydraulic conductivity and soil water diffusivity. After making these changes, the model predicted infiltration, water content distributions, and changes in storage. Using the chemistry component of the model, total dissolved solids were adequately modeled but individual ionic species were not. The calcium salt system (sulfate-carbonate-bicarbonate) was not adequate for these soils. (Cassar-FRC)

W81-04124

DIMETHYLSULFOXIDE IN MARINE AND FRESHWATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.

M. O. Andreada.
Limnology and Oceanography, Vol 25, No 6, p 1054-1063, November, 1980. 4 Fig, 5 Tab, 25 Ref.

Descriptors: *Sulfur compounds, *Dimethylsulfoxide, *Phytoplankton, Algae, Sulfate, Euphotic zone, Marine algae, Estuaries, Lakes, Rivers, Productivity, Rain, Seawater, Chemical reactions.

Dimethyl sulfoxide (DMSO) was found in many samples from the euphotic zone of estuarine and fresh waters. Results were (in nmol per liter): 4 estuarine waters, 5-14, with 86 in a seagrass bed; 9 rivers, less than 1 to 14; and 4 lakes, less than 1 to 6. Below the euphotic zone DMSO was not detected. These results parallel findings for dimethylsulfenic acid in marine samples, suggesting that both compounds are released by marine algae. Seven of eight pure cultures of marine phytoplankton produced significant amounts of DMSO, for example, *Cricosphaera carteri*, 1200 nmol per liter and *Coccolithus huiylei*, 380 nmol per liter. Also tested were diatoms, dinoflagellates, and prasinophyceae. DMSO was also detected in four samples of rain from air masses of marine origin, 5.9-8.3 nmol per liter. A cycle for methylated sulfur compounds in the marine environment has been proposed. Sulfate is incorporated by marine phytoplankton into dimethyl sulfonium compounds and other organosulfur compounds, which undergo enzymatic cleavage and oxidation to give dimethyl sulfide and DMSO. These substances are released into surface ocean water and either enter the atmosphere as dimethyl sulfide or oxidize back to sulfate in the water. Most of the methylated sulfur compounds entering the atmosphere are oxidized to sulfate. (Cassar-FRC)

W81-04128

POLYCYCLIC AROMATIC HYDROCARBONS IN AN ANOXIC SEDIMENT CORE FROM THE PETTAQUAMSCUTT RIVER (RHODE ISLAND, U.S.A.),
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.

R. A. Hites, R. E. LaFlamme, J. G. Windsor, Jr., J. W. Farrington, and W. G. Deuser.
Geochimica et Cosmochimica Acta, Vol 44, No 6,

p 873-878, 1980. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Organic compounds, *Sediments, *Hydrocarbons, Organic matter, Combustion, Industrial wastes, *Pettaquamscutt River, Rhode Island, Fate of pollutants, Carcinogens, Cores, Sampling, Oxidation-reduction potential, Rivers.

Polycyclic aromatic hydrocarbons (PAH) were investigated in sections of an anoxic sediment core from the Pettaquamscutt River, Rhode Island. Total concentrations ranged from 14,000 ppb (1962-75) to 120 ppb (1822-28). Combustion-generated PAH predominated in all sections of the core. Rapid increase in PAH concentrations to 3,000 ppb were evident starting about 1900 with the advent of heavy industrialization. A slight decrease was noticed about 1930, when the annual U.S. energy consumption decreased from 25 times 10 to the 15th power to 18 times 10 to the 15th power British thermal units because of the Depression. Another decrease occurred in 1950, reflecting a change from coal to oil and gas as home heating fuels. It was possible to differentiate between PAH from natural sources (perylene and retene) and those from anthropogenic combustion (pyrene and chrysene). The perylene levels showed an anomaly from 1850-1880, having very low levels of less than 20 ppb compared with several thousands in the years preceding and following. At the same time, retene increased slightly but significantly from about 10-15 ppb to 70 ppb. Possible causes of this anomaly are a change in source of organic matter input or a diagenetic process. Organic carbon remained relatively constant throughout all levels of the core, but changes in C13 were evident during and after the anomaly. (Cassar-FRC)

W81-04136

THE HAZARDS OF TANK SHIPS AND BARGES TRANSPORTING PETROLEUM PRODUCTS ON THE GREAT LAKES,
Wisconsin Univ.-Madison. Sea Grant Inst.

J. P. Keillor.
Coastal Zone Management Journal, Vol 8, No 4, p 319-336, 1980.

Descriptors: *Oil pollution, *Lakes, *Oil tankers, Ships, Water pollution sources, Oil spills, Water pollution prevention, Fathometers, Navigation, Dredging, *Great Lakes.

A description of a tanker trip, analysis of oil spill statistics, and analysis of vessel casualty records reveal the nature of hazards to vessels in the Great Lakes petroleum trade. More oil is discharged per unit volume of water into the great Lakes than into the world's oceans, and the arctic and subarctic environments are susceptible to more damage from oil spills than temperate and tropical waters. In these waters, tank ships averaged two spills greater than 100 gallons per 1000 port calls during 1973-77. This is less than half as many oil spills per port call as have occurred at major Atlantic and Pacific coast ports. Most casualties to Great Lakes tank ships and tank barges are caused by striking fixed objects, colliding with other vessels, or grounding. More use of the Lorcan-C system and fathometers could avoid accidents. Also, more frequent dredging could reduce the incidence of grounding. Potential sources of large spills also include large vessels not used to carry petroleum. Fuel tanks on these vessels can rupture, and the dumping of bilge or ballast water can give rise to oil pollution. (Small-FRC)

W81-04141

A FLUSHING MODEL OF ONSLOW BAY, NORTH CAROLINA, BASED ON INTRUSION VOLUMES,
Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 2L.

W81-04143

WASTE LUBRICATING OIL DISPOSAL PRACTICES IN PROVIDENCE, RHODE ISLAND: POTENTIAL SIGNIFICANCE TO COASTAL WATER QUALITY,
Rhode Island Univ., Kingston. Graduate School of

Sources Of Pollution—Group 5B

Oceanography.

E. J. Hoffman, A. M. Falke, and J. G. Quinn.
Coastal Zone Management Journal, Vol 8, No 4, p 337-348, 1980. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Lubricants, *Oil, *Domestic wastes, Petroleum hydrocarbons, Waste disposal, Water pollution sources, Water pollution prevention, Rhode Island, Providence, Use motor oil.

A 1979-80 survey of Providence, Rhode Island residents, determined how those who changed their own automotive lubricating oil disposed of the oil. Thirty-five percent of the residents changed their own oil. The following disposal methods were used: 41% garbage, 30% dumping in backyard, 8% pouring down drains or sewers, 7% giving to a service station, 5% pouring it on the road, and 3% taking it to the town dump. Pouring the oil into sewers or on the road resulted in 44 metric tons of petroleum hydrocarbons being discharged to the city's waste water treatment system. This could account for 19% of the total hydrocarbons discharged by the combined storm sewer and sanitary sewage treatment plant each year. These hydrocarbons are discharged into the Providence River. The residents indicated a high degree of willingness to participate in a recycling program. The program, recently passed by the State Legislature of Rhode Island, could have a beneficial effect on the water quality of Narragansett Bay. (Small-FRC)
W81-04144

HEAVY METAL-ANTIBIOTIC RESISTANT BACTERIA IN A LAKE RECREATIONAL AREA, Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.

R. E. Sjogren, and J. Port.
Water, Air, and Soil Pollution, Vol 15, No 1, p 29-44, 1981. 5 Fig, 8 Tab, 37 Ref.

Descriptors: *Heavy metals, *Coliforms, *Bacteria, Streptococcus, Beaches, Path of pollutants, Adaptation, Lakes, Water pollution sources, Sewage bacteria, Microorganisms, *Lake Champlain, Vermont, Recreation facilities.

Distributions of fecal pollution indicators and organisms resistant to heavy metals and antibiotics were studied during the summers of 1974 and 1977 in waters and sediments of a recreational area of Lake Champlain near Burlington, Vermont. It was determined that the major source of pollution was in the southern part of the bay (illegal raw sewage dumping by moored boats). Prevailing winds and currents encouraged a northward drift of pollution to a major bathing area. Fecal coliforms, fecal streptococci, and total coliforms were usually 10 to 100 fold higher in sediments than in water samples. Levels frequently exceeded acceptable levels for recreational waters. In harbor water samples, 84% of total coliforms were resistant to 1 or more antibiotics; 96% were resistant to 2 or more heavy metals (Co, Zn, and Pb). (Cassar-FRC)
W81-04151

ANOMALIES IN THE LOG FREUNDLICH EQUATION RESULTING IN DEVIATIONS IN ADSORPTION K VALUES OF PESTICIDES AND OTHER ORGANIC COMPOUNDS WHEN THE SYSTEM OF UNITS IS CHANGED, Department of Agriculture, London (Ontario). Research Inst.

B. T. Bowman.
Journal of Environmental Science and Health, Vol B16, No 2, p 113-123, 1981. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Mathematical equations, *Adsorption, *Soil water, Kinetics, Mathematical studies, Pesticides, Soil types, *Path of pollutants, Mathematical analysis, Organophosphorus pesticides, chlorinated hydrocarbons, Insecticides, Isotherms, Organic compounds.

The Freundlich equation K value is widely used to estimate the adsorption of pesticides in soil-water systems. Some anomalies in adsorption values created by the use of this equation are examined, and precautions necessary when using the K values to

measure the relative adsorption of pesticidal compounds in soil-water environments are discussed. Dimensionless analysis of the Freundlich equation reveals that the units of K are not moles/gram. When units are changed, the magnitude of K does not change by the same factor as the adsorption data from which it was calculated, except when the slope (N) equals 1. It was suggested that mole fraction (a unitless quantity) be used to express the equilibrium concentration, and that K should no longer be utilized as an indicator of relative adsorption. The effect of slope value on the magnitude of adsorption K value with changing units is illustrated for the adsorption of several organochlorine and organophosphorus insecticides on various soil-water systems. An alternate method of determining the relative adsorption of pesticides by soil-water systems is evaluated. (Geiger-FRC)
W81-04189

DETERMINATION OF THE AQUATIC HERBICIDE FLURIDONE IN WATER AND HYDROSOIL: EFFECT OF APPLICATION METHOD ON DISSIPATION,

Lilly Research Labs., Greenfield, IN. Agricultural Research Div.
For primary bibliographic entry see Field 5A.
W81-04192

SURVEY FOR SURFACTANT EFFECTS ON THE PHOTODEGRADATION OF HERBICIDES IN AQUEOUS MEDIA,

Science and Education Administration, Fargo, ND. Metabolism and Radiation Research Lab.
F. S. Tanaka, R. G. Wien, and E. R. Mansager.
Journal of Agricultural and Food Chemistry, Vol 29, No 2, p 227-230, March-April, 1981. 3 Tab, 9 Ref.

Descriptors: *Herbicides, *Degradation, *Surfactants, Pesticides, Fate of pollutants, Carbamate pesticides, Triazine pesticides, Urea pesticides, Solubility, High pressure liquid chromatography, Irradiation, Decomposition, Chemical reactions.

The effects of 0.2% heterogeneous Tergitol TMN-10 and Triton X-100 on the photodegradation of four classes of herbicides in aqueous solutions were examined. Aqueous solutions of phenylureas, carbamates, amides and triazines were irradiated for 135 minutes with a Rayonet photoreactor. Measurement of unreacted parent material after photolysis was carried out by high pressure liquid chromatography. The 14 compounds tested were chosen to give a wide range of water solubilities for each class. No direct relationship was observed between water solubility and surfactant effects. However, an increase in herbicidal photo-degradation was observed as water solubilities decreased in the presence of surfactant under qualifying conditions. In general, herbicides with low water solubilities and one or more chloro-substituents on the aromatic ring showed this effect consistently, except for the 3,4-dichloro substitution. The implications of these findings for the environmental fate of pesticides are discussed. (Geiger-FRC)
W81-04194

PHOSPHORUS SOURCES FOR AQUATIC WEEDS: WATER OR SEDIMENTS', McGill Univ., Montreal(Quebec). Dept. of Biology.

R. Carignan, and J. Kalf.
Science, Vol 207, No 4434, p 987-989, February 29, 1980. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Phosphorus compounds, *Aquatic plants, *Sediments, Lakes, Quebec, Nutrients, Path of pollutants, Lake Memphremagog, Riviere du Sud, Bottom sediments.

The sediments in mesotrophic and mildly eutrophic lakes contributed all the phosphorus used by nine common species of aquatic macrophytes. In central Lake Memphremagog, Quebec (mean total P, 9.7 micrograms per liter) plants and their % P uptakes from the sediment were as follows: Myriophyllum alterniflorum, 104.4; Potamogeton zosteriformis, 107.4; Potamogeton foliosus, 98.6; Callitrichia hermaphroditica, 94.2; Elodea canadensis,

99.0; Najas flexilis, 100.8; Myriophyllum spicatum, 99.4; Heteranthera dubia, 95.2; and Vallisneria americana, 103.1. In southern Lake Memphremagog (mean total phosphorus 29.8 micrograms per liter) results were as follows (in %): M. spicatum, 93.2; H. dubia, 95.7; and V. americana, 86.0. In hypereutrophic Riviere du Sud (mean total phosphorus, 290 micrograms per liter) % P uptake from sediments was slightly less: M. spicatum, 70.0; H. dubia, 70.3; and V. americana, 74.2. Submerged macrophytes are very active sediment P recyclers and should be seen as potential P pumps. (Cassar-FRC)
W81-04197

SOME EVOLUTIONAL ASPECTS OF THE CONTAMINATION OCCURRENCE IN THE ALBUFERA LAKE,

Valencia Univ., Politecnica(Spain). Instituto de Hydrologia y Medio Natural.
J. Alonso, and M. Ferris.

Progress in Water Technology, Vol 12, No 4, p 523-542, 1980. 7 Fig, 5 Tab, 4 Ref.

Descriptors: *Path of pollutants, *Lakes, *Time series analysis, Albufera Lake, *Spain, Agricultural runoff, Water pollution sources, Water quality.

Albufera lake water was analyzed in a study involving the irrigation canals discharging water into the lake, which is one of the ways the lake is contaminated. A comparison of the results with published data led to a finding of some parameter changes during the past six years. The origin of agricultural contamination was found to come from the entire lake area, especially from the southeast; urban contamination, although diffuse, comes from the west; and industrial contamination, together with urban contamination, was very accentuated in the northern part of the lake. The odor and color, suspended substances, dissolved oxygen, BOD5, organic matter, hardness and turbidity were determined. Comparison with previously set legal limits for these properties showed the progressive contamination of the lake. (Hertzoff-FRC)
W81-04202

POLLUTION CONTROL AND QUALITY LEVELS OF THE BAY OF NAPLES,

Naples Univ. (Italy). Centro Studi Ricerche di Ingegneria Sanitaria.

L. Menda, E. d'Elia, L. Evison, and E. Tosti.
Progress in Water Technology, Vol 12, No 4, p 615-631, 1980. 6 Fig, 5 Tab.

Descriptors: *Outfall sewers, *Coliforms, *Bays, Monitoring, Public health, *Water pollution sources, *Bay of Naples, Italy, Naples.

Pollution control in the Bay of Naples was studied, and the main pollution sources and their loads were determined. Data are also presented on the bacteriological monitoring of the seawater. Bacterial counts indicate that the following are the primary sources of pollution: the municipalities of Cuma, Bagnoli, Coroglio, and S. Giovanni, and the River Sarno. While there were some areas of heavy fecal contamination, in general the water quality was very good. In places where there was no sewage discharge, such as near Lago Lucrino and Capo Posillipo, the bacterial quality of the water was excellent. E. coli counts appeared to reflect the fecal contamination of the water more accurately than total coliforms. A high correlation was found between total coliforms and fecal coliforms, and between fecal coliforms and fecal streptococci. Low levels of dissolved oxygen were measured around the Cuma outfall, S. Giovanni a Teduccio outfall, and River Sarno. At present, 20% of the planned treatment works are in operation in the area studied. (Small-FRC)
W81-04203

GROUNDWATER POLLUTION BY OIL PRODUCTS,

Anglian Water Authority, Huntingdon (England). A. Hunter Blair.

Journal of the Institution of Water Engineers and Scientists, Vol 34, No 6, p 557-569, November,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

1980. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Groundwater pollution, *Infiltration, Surface-groundwater relations, Oil spills, Groundwater, Cleanup operations, *Oil pollution, Chromatography, Aquifer characteristics, Petroleum hydrocarbons, England.

Aspects of groundwater pollution by oil products in England are examined, and legal controls and required research are discussed. Studies indicate that most inland oil pollution results from small sources such as tank leaks, spills from stocking and handling, and washing from contaminated surface. Additional sources of pollution include illegal dumping of wastes and accidents to road, rail, and other transport. The resulting deterioration in groundwater quality endures for long periods of time, exceeding 70 years. The quantitative mechanisms of flow following an oil spill and the breakdown of oil products by microorganisms, as well as the effects of bedrock chemistry on oil must be understood before attempts can be made to understand oil behavior in groundwater. Current estimates of the spread and migration of oil based on experience differ from those obtained by complex mathematical solutions. Mechanisms of oil pollution must be understood before attempts can be made to obtain an oil balance. Recovery following oil pollution is further complicated by the necessity for quick action, extensive knowledge of the local geology, and long term maintenance, and the exorbitant costs encountered. Increased protective measures and increased numbers of trained personnel are needed as well. (Titus-FRC)

W81-04214

ISOLATION AND ENUMERATION OF LISTERIA MONOCYTOGENES FROM SEWAGE, SEWAGE SLUDGE AND RIVER WATER,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 2A.

W81-04219

HYDROLYSIS OF SELECTED ORGANOPHOSPHORUS INSECTICIDES BY TWO BACTERIA ISOLATED FROM FLOODED SOIL,

Central Rice Research Inst., Cuttack (India). Lab. of Soil Microbiology.

T. K. Adhya, Sudhakar-Barik, and N.

Sethuraman.
Journal of Applied Bacteriology, Vol 50, No 1, p 167-172, 1981. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Microbial degradation, *Soil bacteria, *Organophosphorus pesticides, Flavobacterium, Pseudomonas, Pesticides, Hydrolysis, Bacteria, Insecticides, Microbiological studies, Glucose, Diazinon, Parathion, Enzymes, Fenitrothion, Methyl parathion.

Although microbial hydrolysis of parathion and related phosphorothioate insecticides with a common P-O-C linkage has been well demonstrated, not all phosphorothioates with a common P-O-C linkage were hydrolyzed with ease by a crude enzyme from a mixed bacterial culture. The hydrolysis of both diethyl (parathion and diazinon) and dimethyl (methyl parathion and fenitrothion) phosphorothioates by Flavobacterium sp. ATCC 27551 and Pseudomonas sp. ATCC 29353 was investigated. The Flavobacterium sp. hydrolyzed both the diethyl and the dimethyl phosphorothioates, while the Pseudomonas sp. hydrolyzed only the diethyl phosphorothioates. Glucose inhibited the hydrolysis of parathion by Pseudomonas sp., but not by Flavobacterium sp. The Pseudomonas sp. converted 4-nitrophenol to 4-aminophenol in the presence of glucose and to nitrite in its absence; 4-nitrophenol was not metabolized by the Flavobacterium sp. This study demonstrated the exceptional capacity of the Flavobacterium sp. to rapidly hydrolyze a variety of phosphorothioates with structural differences in their alkyl or ring portions. These bacteria may be particularly useful in the development of immobilized enzyme systems for the detoxification of pesticide wastes. (Carroll-FRC)

W81-04222

UNDERSTANDING WATER QUALITY,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
M. H. Bates.

Southwest and Texas Water Works Journal, Vol. 61, No. 12, p 6-7, March 1980.

Descriptors: *Chemical reactions, *Water quality, *Hydrogen ion concentration, *Oxidation-reduction potential, *Water treatment, Heavy metals, Nutrients, Dissolved oxygen, Pollutants, Phosphorus compounds.

An understanding of chemical factors in water is important in producing a good quality water for domestic use. While most natural waters have a pH between 6.5 and 8.5 maintained by the carbonate-bicarbonate buffering system, several conditions can cause temporary pH changes, including intense photosynthesis activity and microbial metabolism. These fluctuations affect precipitation-solubilization reactions and sorption-desorption reactions, changing the availability of phosphates and heavy metals. Dissolved oxygen concentrations govern the oxidation-reduction potential. Fluctuations are caused by temperature changes and photosynthesis. Many elements have several oxidation states and move between them with changes in dissolved oxygen concentration, for example, Fe, S, Ni, Cu, Cr, and Hg. Knowledge of these chemical reactions can improve proper choice of treatment methods. (Cassar-FRC)

W81-04245

POLLUTION STUDIES ON NIGERIAN RIVER II: WATER QUALITY OF SOME NIGERIAN RIVERS,
Ibadan Univ. (Nigeria). Dept. of Chemistry.
S. O. Ajayi, and O. Osibanjo.
Environmental Pollution (Series B), Vol. 2, No. 2, p 87-95, 1981. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Rivers, *Water quality, *Rural areas, Organic matter, Biochemical oxygen demand, Water pollution sources, Hydrogen ion concentration, Humus, Decomposing organic matter, Water quality, Standards, Africa, "Nigeria".

Twenty-six Nigerian rivers were sampled during the dry season, and samples were analyzed for BOD₅, COD, pH, dissolved oxygen, ammonia, nitrite, and phosphate. Since industrialization and urbanization have been at a low level in most of Africa, there are few polluted rivers and little data on water quality. Recent increased industrial activities including an oil boom have affected water quality. Ten of the rivers studied are tributaries of the River Niger, and only two of the rivers flow through heavily populated areas. Seventeen of the rivers were found to be unpolluted. Nine were found to be polluted, but by natural sources. The river with the highest BOD and lowest pH and dissolved oxygen flowed through the freshwater swamp forest area of southwestern Nigeria, where the drainage and catchment areas are rich in decaying organic matter and humus. Some poor water quality measurements were due to heavy deposits of cow dung near the sampling sites. Information on the natural quality of these rivers will aid in establishment of realistic standards for water quality. (Small-FRC)

W81-04249

THE WATER POLLUTION POTENTIAL FROM DEMOLITION WASTE DISPOSAL,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.

D. W. Ferguson, and J. W. Male.
Journal of Environmental Science and Health, Part A, Environmental Science and Engineering, Vol A15, No 6, p 545-559, 1980. 3 Tab, 9 Ref.

Descriptors: *Water pollution sources, *Landfills, *Waste disposal, Demolition wastes, Leachate, Paths of pollutants, Disposal, Solid wastes, Construction wastes, Pollutants, Surface waters, Groundwater, Metals, Alkalinity, Hardness(Water), Iron, Manganese, Conductivity, Wood wastes.

Results of field and laboratory studies on water samples from demolition waste sites showed poten-

tial for pollution of surface waters and groundwaters. Although highly variable, the composition of the wastes can be divided into combustible (mostly wood) and noncombustible (concrete and masonry rubble, plastic wiring, piping, etc.). The four disposal sites, located in southern New England and in contact with surface and groundwater, varied widely in size, content, and other characteristics. Results showed that downstream water samples in most sites had significant increases in hardness, alkalinity, conductivity, COD, iron, and manganese. Some extreme levels (all expressed in mg per liter) were iron, 40; Mn, 9.0, EDTA hardness, 1100; and COD, 270. Pb, Cu, Cd, and Cr were below detectable limits. Laboratory studies used 2 different compositions of demolition wastes, one 50% wood and the other 50% masonry waste with the remainder typical demolition materials. Results were similar to the field results but could not evaluate the effect of leaching through soil. Disposal sites for demolition wastes must be chosen and designed to minimize pollution of surface and ground waters. (Cassar-FRC)

W81-04255

THE RELATIONSHIP BETWEEN ACID CONTENT OF PARTICULATES AND RAINFALL IN BANGKOK,

College of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.

S. M. Khan.

Journal of Environmental Science and Health, Part A, Environmental Science and Engineering, Vol A15, No 6, p 561-572, 1980. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Bangkok, *Acidic water, *Rainfall, *Water pollution sources, *Acid rain, Thailand, Hydrogen ion concentration, Sulfates, Sulfuric acid.

Rainfall at nine stations in Bangkok, Thailand, varied from pH 5.57 to 6.32, low values compared with cities in North America and Europe. Particulate acid content ranged from 5.38 to 10.15 micrograms per cu meter. Analysis for several ions showed that the concentration of sulfate was the controlling factor in acidity of rain. pH was reduced by 1 unit for each 9.0 micrograms per cu meter acid content of particulates according to a relationship derived in the study: pH = 6.87 - 0.11 (acidity of particulates in micrograms per cu meter). (Cassar-FRC)

W81-04277

TRADITIONAL PRACTICES OF HANDLING DRINKING WATER IN TROPICAL DEVELOPING COUNTRIES - BOON OR HAZARD FOR NEW RURAL WATER SUPPLY PROJECTS,
Water Purification Project, Khartoum (Sudan).

S. A. A. Jahn.

Aqua, No 9/10, p 14, 15, 1980. 10 Ref.

Descriptors: *Tropical regions, *Water supply, *Social aspects, Water quality, Bacteria, Developing countries.

This paper highlights some traditions in handling of water in rural areas of the tropics which must be taken into consideration in any attempts to upgrade the water supply to that region. Even if the water supply in some areas is changed from an unsafe water to high quality groundwater, the women in the area will still cover the pots during transport from the source to their homes with broad leaves of *Terminalia macrocarpa* or other plants. This habit can increase the contamination of the water and promote bacterial growth on the organic matter which soaks from the leaves. Baobab trees are frequently used as rain water reservoirs. Not only is this water open to contamination from bird and bat droppings, organic matter and dust, but it may also have been placed into the tree shortly after the tree had been tarred for repairing inside walls of the trunk. A practice in Mali calls for placing a layer of fresh kaolin in the bottom of a clay jar before it is filled with water. Studies on Sudanese clays for water coagulation are underway. Use of the perfumed grasses to favor the water or spruce up a flat taste is common. The effects of these traditional practices are under investigation. (Baker-FRC)

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

W81-04285

METABOLISM OF BIOELEMENTS IN THE MINAMI-ASAOKAWA RIVER AND HUMAN ACTIVITIES AFFECTING IT.

Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.

N. Ogura.

Japanese Journal of Limnology, Vol 41, No 3, p 138-146, July, 1980. 8 Fig., 4 Tab., 10 Ref.

Descriptors: *Sewage effluents, *Self-purification, *Rivers, *Nutrients, Water pollution effects, *Minami-Asakawa River, Japan, Eutrophication, Nitrogen compounds, Phosphorus compounds, Path of pollutants, Suspended solids, Chlorophyll, Algae, Diurnal.

Water samples from the sewage-polluted Minami-Asakawa River, Japan, were collected every three hours during July 25-26, 1978, and daily loadings and budgets of bioclements estimated. Suspended matter, organic N, carbohydrates, and ammonia decreased along the course of the river because of self-purification. However, nitrate, nitrite, and chlorophyll a, produced in situ, increased throughout the day. Diurnal variations were observed: current velocity, electrical conductivity, and water temperature decreased to a minimum about 6 a.m. Several other parameters of water quality reached low levels about 3 a.m.—total P, total organic carbon, and nitrate-N. Substances enter the river system by precipitation, sewage discharge and other inputs, and gas exchange on the surface; are metabolized or dissolved in water and sediments by fish, microorganisms, benthos, algae, and macrophytes; and are output via evaporation, gas exchange at the surface, settling, seepage through the bed into the groundwater, and outflow toward the sea. (Cassar-FRC)

W81-04294

TIDAL SEDIMENT TRANSPORTATION AND BEHAVIOR OF PARTICULATE PHOSPHORUS AND HEAVY METALS IN A POLLUTED TIDAL RIVER.

Aichi Environmental Research Center, Nagoya (Japan).

H. Otsuka, and M. Furuta.

Japanese Journal of Limnology, Vol 41, No 3, p 172-181, July, 1980. 11 Fig., 24 Ref.

Descriptors: *Phosphorus compounds, *Heavy metals, *Sediment transport, Organic matter, Suspended solids, Path of pollutants, Manganese, Zinc, Copper, Lead, Iron, Estuaries, *Tidal rivers, Bottom sediments, Storms, Metals, *Shonai River, Japan.

Concentrations of phosphorus and heavy metals in water and suspended matter were studied in a polluted tidal river (Shonai River, near Nagoya, Japan) during sediment transportation. After sediment disturbances, levels of P and heavy metals in particulate form increased. The most mobile forms of P and metals in the suspended matter were hydroxylamine acetic acid soluble P and metals and hydrogen peroxide soluble P. Hydrogen peroxide soluble P and hydroxylamine acetic acid soluble Zn, Cu, and Pb were associated with organic matter, and hydroxylamine acetic acid soluble P with iron hydroxide. Concentrations in suspended matter were less during frequent sediment transport (rainy weather) and higher during dry weather. The mobile P and metals were lost from suspended matter during the process of settling to the bottom and accumulated in bottom sediments during periods of stable weather because supply was greater than loss. Mn did not accumulate in suspended matter or bottom sediments in the semi-reducing conditions encountered in this study. (Cassar-FRC)

W81-04296

THE FLORA OF AEROBIC HETEROTROPHIC BACTERIA IN THE RIVER SAGAMI, Samukawa Purification Plant, Kanagawa (Japan).

S. Maeda.

Japanese Journal of Limnology, Vol 41, No 3, p

163-171, July, 1980. 1 Fig., 5 Tab., 28 Ref.

Descriptors: *Bacteria, *Periphyton, *Rivers, Heterotrophic bacteria, Aerobic bacteria, Aquatic bacteria, Limnology, *Sagami River, Japan, Aquatic plants, Coliforms, Sediments, Bottom sediments.

The number and species of aerobic heterotrophic bacteria in running water, periphyton, and sediments of the Sagami River, Japan, were studied. Total numbers of aerobic heterotrophic bacteria were 10,000 to 1 million cells per ml in water, 1 million to 10 million cells per sq cm in periphyton, and 2.5 to 4.3 million per gram in sediments. Most numerous bacteria in water were *Flavobacterium* (31.3-43.8%), *Acinetobacter* (0.28-1%), and *Moraxella* (0.18-3.8%); in periphyton, *Flavobacterium* (28.1-62.5%), *Alcaligenes* (6.3-25.0), and *Moraxella* (6.3-37.5%); in sediments, *Pseudomonas* (8-20%), *Alcaligenes* (8-20%), *Acinetobacter* (8-12.5%), and *Flavobacterium* (0-16%). (Cassar-FRC)

W81-04300

5C. Effects Of Pollution

EFFECTS OF POLLUTANTS ON HUMAN HEALTH,

Health effects Research Lab., Cincinnati, OH.

L.J. McCabe.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sept. 16-17, 1980, Chicago, IL. EPA Report EPA-905/9-80-009, Sept. 80. p 55-61, 1 Fig., 1 Tab., 5 Ref.

Descriptors: *Public health, *Water pollution effects, Waste water facilities, Aerosols, Toxicity, *Infaction, *Swimming, Population exposure, Environmental effects, Site selection, Sewage bacteria, Bacterial analysis, Bioaccumulation, Fish.

The Environmental Protection Agency's health effects laboratories conduct research to provide data for standards setting purposes. Research activities which may be germane to point versus diffuse source pollution include studies on bathing beaches, aerosols from sewage treatment plants, and toxic effluents. In order to determine new criteria for recreational water quality, a study was conducted in which water quality was measured by as many methods as possible and then correlated with illness related to sewage pollution. The best indicator to fit the illness data was the *Enterococcus* density as measured by a method developed in the study. For an increased illness rate of 1%, the *Enterococcus* density would be 13.6 per decaliter and for 5% increased illness, 906 per 100 ml. Another problem area studied was the health effects of siting of sewage treatment plants. Despite the fact that some microorganisms are emitted by aeration basins of a sewage treatment plant, there is no detectable increase of disease in persons exposed to the aerosols, including sewage treatment plant workers. As part of the development of Criteria Documents, the laboratory was involved in determining the human health effects portion of 20 of the 65 consent decree documents, most critical to the Great Lakes are the toxic pollutants that have significant bioaccumulation. Because of the Great Lakes fishery resource such toxic pollutants will require close surveillance, particularly in populations where the average fish consumption is greatly exceeded. (Brambley-SRC)

W81-03966

HIGH FLOW WATER QUALITY STANDARDS, Southeastern Wisconsin Regional Planning Commission, Waukesha.

L. F. Wible.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sept. 16-17, 1980, Chicago, IL. EPA Report EPA-

Effects Of Pollution—Group 5C

905/9-80-009, Sept. 80. p 329-333.

Descriptors: *High flow, *Nonpoint pollution sources, *Water quality standards, *Water pollution sources, Low flow, Aquatic life, Fisheries, Dissolved oxygen, Water temperature, Ammonia, Nitrogen, Hydrogen ion concentration, Phosphorus, California, monitoring.

Recent water quality monitoring programs have indicated that water pollution is not exclusively a dry weather, point source related problem. To formulate an applicable water quality standard which would support the intended water use objectives, an analysis was made of water quality monitoring data from those streams in the Southeastern Wisconsin Region that have relatively clean water and healthy fisheries, and for which water use objectives are considered to be met. Even in such relatively clean streams, the specified water quality standards are not met all of the time. A 95% compliance level was selected as a practical criterion for meeting those indicators which directly affect desirable forms of aquatic life. These include dissolved oxygen, temperature, un-ionized ammonia nitrogen and pH. A 90% compliance level was selected as the criterion for those indicators which do not directly affect aquatic life. These include phosphorus and fecal coliform organisms. This probabilistic approach to water quality standards is recommended for use as a supplement to the current exemption in Wisconsin standards for low flow conditions. The recommendation renders it more complex to interpret a field-sampled water quality violation. This procedure will require the development of new field techniques, or interpretive methods for the analysis of field survey data. (Moore-SRC)

W81-03983

THE USE OF COMMUNITY PARAMETERS DERIVED FROM ELECTROFISHING CATCHES OF RIVER FISH AS INDICATORS OF ENVIRONMENTAL QUALITY,

DePauw Univ., Greencastle, IN. Dept. of Zoology.

J. R. Gammon.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 335-363, 11 Fig., 3 Tab., 14 Ref.

Descriptors: *Water quality, *Fish populations, *Environmental effects, *Species composition, Aquatic environment, Diversity indices, Rivers, Species diversity, Biological communities, Biomass.

There is a pronounced need for methods of measuring the effect of various human activities on the aquatic communities of running water ecosystems. The composite index of well-being combines two indices of diversity and two indices of abundance in approximately equal quantities to reflect both diversity and abundance of fish. It appears to reflect the general health of the fish community and hence, the water quality somewhat more satisfactorily than any single community index of indicator species. The findings of this community structure approach as applied to the Wabash and Great Miami Rivers are examined and evaluated. The fish communities of these rivers are formed from the same species, with some exceptions. These communities respond to various environmental stresses by reorganizations in species composition. It appears that different indices of community structure may provide a means of detecting subtle shifts in stressed communities and that a blend of different indices, for example the composite index, may serve to magnify and clarify the community response to subtle perturbations. Although there are differences in relative density and relative biomass, the composite indices are very similar for good, intermediate, and poor communities in the two rivers, approximately 7.5 for good communities, 6.25 for intermediate communities and 5.0 for poor communities. This kind of approach may be of value for other rivers of this kind. (Moore-SRC)

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

W81-03984

A CONCEPTUAL MODEL FOR AN INTEGRATED ENVIRONMENTAL ANALYSIS ON OIL SHALE TRACT C-B, Bureau of Land Management, Fort Collins, CO. Office of Planning, Inventory, and Environmental Coordination.

P. T. Haug, and G. M. Van Dyne.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, Colorado. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980. p 63-85, 7 Fig, 5 Tab, 2 Ref.

Descriptors: *Model studies, *Baseline studies, *Environmental effects, *Oil shale, *Ecosystems, Planning, Resources development, Ecology, Hydrology, Climatic data.

In accordance with lease stipulations requiring that system interrelationships be addressed in the environmental baseline program, a conceptual model of the oil shale Tract C-b ecosystem was developed around 2.5 years of hydrological, meteorological, and ecological baseline data. A systematic procedure was used to organize, classify, summarize, integrate, and synthesize the baseline data into categories of key ecosystem components and processes. The operator's detailed development plans for the oil shale were used to identify anticipated perturbations to the ecosystem. These perturbations were integrated into the conceptual model along with the key components and processes. Five ecosystem response units (ERU) were identified in the natural system, and two additional ERU's would be imposed by oil shale development. Most of the data for driving variables and state variables were plotted against a 2.5 year time scale. Three matrices were derived from the operator's development plan and its modification. They were the development matrix, the activity matrix, and the perturbation matrix. The model describes major interrelationships on the tract from a systems perspective, from a mainly qualitative approach. (Brambley-SRC)

W81-03988

GROUNDWATER QUALITY SAMPLING APPROACHES FOR MONITORING OIL SHALE DEVELOPMENT.

General Electric Co., Santa Barbara, CA. Center for Advanced Studies.

G. C. Slawson, Jr., and L. G. McMillion. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, Colorado. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980. p 86-100, 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Wells, *Oil shale, *Resources development, *Monitoring, *Groundwater pollution, Cost analysis, Sampling, Water quality control, Pollutants, Hydrogeology, *Baseline studies, Data acquisition.

The development of cost-effective groundwater quality monitoring programs for oil shale development requires a structured (or planned) assessment process leading to selection of sampling sites and sampling methods. A study is being conducted to assess the impacts of oil shale development on groundwater quality and to develop monitoring design guidelines. One of the roles of a structured design methodology is to assure the quality of monitoring data. This is accomplished by defining monitoring goals, evaluating monitoring options, and creating a framework for assessing cost-effectiveness. The groundwater quality monitoring design process includes: identification and characterization of potential sources of groundwater quality impact; characterization of the location of these sources with regard to hydrogeology and existing groundwater quality; assessment of mobility and attenuation of potential pollutants in the

subsurface; and development of a priority ranking of potential sources of impact and of potential pollutants. Because of the complexity of the hydrogeology of the oil shale region special problems are presented in the selection of sampling sites, well construction, sample collection methods, and sampling frequency. (Brambley-SRC)

W81-03989

A CONTINUOUS FLOW BIOASSAY TECHNIQUE FOR ASSESSING THE TOXICITY OF OIL SHALE RELATED EFFLUENTS: PRELIMINARY RESULTS WITH TWO SPECIES OF CADDISFLY LARVAE.

California Univ., Berkeley. Lawrence Berkeley Lab.

P. P. Russell, V. H. Resh, and T. S. Flynn.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, Mar 26-28, 79, Denver, CO. EPA Report EPA-600/9-80-022, Jun 80. p 416-430, 1 Fig, 4 Tab, 19 Ref.

Descriptors: *Oil shale, *Process water, *Bioassay, *Caddisflies, *Water pollution effects, *Larvae, Insect behavior, Ammonium carbonate, Effluents, Environmental effects, Toxicity, Bioindicators.

Caddisfly larvae were exposed to different concentrations of Omega-9 oil shale wastewater, filtered and unfiltered, and a synthetic wastewater compounded from ammonium carbonate. The species used were *Guemaga nigricula* and *Dicosmoecus vilpivae*; the Omega-9 dilutions were 0.27%, 1.06%, and 2.12%; and the ammonium carbonate strengths were 0.56, 2.26, and 4.52 mM. *Guemaga* larvae can be maintained in the laboratory model streams with no effluent loading at nearly 100% survival for at least 12 days. Concentrations of filtered Omega-9 water up to 2.12% and unfiltered Omega-9 water up to 1.06% produce no demonstrable reductions in *Guemaga* 'activity' after 9 days of exposure in the model streams. *Guemaga* 'activity' is not notably reduced by rearing in streams receiving up to 4.52 mM concentrations of ammonium carbonate in the makeup water for 9 days. The 'activity' of *Dicosmoecus* larvae in the laboratory model streams that were fed ammonium carbonate concentrations of 4.52 mM and 2.26 mM is significantly reduced but not at a dilution of 0.56 mM. They were not exposed to the Omega-9 water. *Dicosmoecus* larvae are potentially more sensitive indicators of environmental stress from ammonia-containing effluents than are *Guemaga* larvae. This continuous flow bioassay technique has many potential applications in assessing the toxicity of oil shale related effluents. (Brambley-SRC)

W81-03995

BIOLOGICAL MONITORING OF OIL SHALE PRODUCTS AND EFFLUENTS USING SHORT TERM GENETIC ANALYSES.

Oak Ridge National Lab., TN.

T. K. Rao, J. L. Epler, M. R. Guerin, J. J. Schmidt-Collerus, and L. Lefler.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Samp, Analysis and Quality Assurance, Mar 26-28, 79, Denver, CO. EPA Rept EPA-600/9-80-022, June, 80. p 431-442, 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Bioassay, *Monitoring, *Oil shale, *Process water, *Mutagens, *Salmonella*, Hydrocarbons, Aromatic compounds, Hazardous materials, Oil, Effluents, Pollutants.

The long term health hazards such as mutagenesis, carcinogenesis and teratogenesis due to the exposure to crude shale oil, particulate pollutants and the leachates from raw or spent shale constitute a major concern in the development of shale oil technology. In order to monitor such biological effects, short term genetic analyses were conducted with the exemplary test materials. These samples included crude oil from oil shale, an aqueous product water, and carbonaceous spent shale. The

Salmonella/microsomal activation system (Ames assay) was generally applicable but only upon chemical fractionation. The Stedman liquid/liquid extraction procedure or the Sephadex gel filtration (LH-20) technique were effectively utilized. Mutagenicity analyses with crude oils and product water revealed biological activity in the basic (aromatic amine fractions) and in the neutral (polycyclic aromatic hydrocarbon fraction) fractions. Extracts and chromatographically isolated materials from raw and spent shale showed mutagenic activity which correlates with the biological activity of compounds that are either identified or predicted to occur in these materials. The testing of crude mixtures with the Ames system is considered a useful approach in the prescreening for mutagens, provided that the appropriate fractionation, chemical analyses, and validation accompany the bioassays. (Brambley-SRC)

W81-03996

AQUATIC TOXICITY TESTS ON INORGANIC ELEMENTS OCCURRING IN OIL SHALE.

Thomas Hunt Morgan School of Biological Sciences, Lexington, KY.

W. J. Bireg, J. A. Black, A. G. Westerman, and J. E. Hudson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, Mar 26-28, 79, Denver, CO. EPA Rept EPA-600/9-80-022, Jun 80. p 519-534, 1 Fig, 3 Tab, 57 Ref, OWRT-B-044-KY(2).

Descriptors: *Oil shale, *Toxicity, *Lethal limit, Larvae, Heavy metals, Pollutants, Environmental effects, Process water, Synergistic Effects.

Using the rainbow trout (*Salmo gairdneri*), embryo-larval toxicity tests were performed on 33 elements which occur in oil shale and other fossil fuels. Continuous exposure was maintained from fertilization through 4 days posthatching, employing static renewal procedures and test responses were based on lethality and teratogenesis. The LC50's were under 1.0 mg/l for 19 of the 33 elements, indicating high sensitivity of developmental stages of the rainbow trout to a wide range of elements which occur in oil shale, spent shale, and process waters. Elements which proved most toxic to trout eggs and larvae were Hg, Ag, La, Ge, Ni, Cu, and Cd, with probit-derived LC50's of 0.005, 0.01, 0.02, 0.05, 0.22, and 0.14 mg/l, respectively. Exposure levels which produced 1% control-adjusted impairment of test populations (LC1) were also determined by log probit analysis, to provide a basis for estimating threshold concentrations. The LC1 values were at or under 10 micrograms per liter for 12 elements, including Ag, Be, Cd, Cu, Ce, Hg, La, Ni, Pb, Tl, V, and Zr. Static renewal tests with trout embryo-larval stages afforded a reliable and economical means of screening oil shale contaminants for toxic properties, identifying those of greatest concern to aquatic ecosystems, and estimating concentrations which may produce hazardous effects. The elemental compositions of oil shale, spent shale, and retort waters are compared in tabular form. Trout embryo-larval tests also were conducted on simple metal mixtures to evaluate possible antagonistic, additive, or synergistic interactions. Mercury was mixed in equal proportions with each of three other metals, including cadmium, copper, and selenium. At lower exposure levels, copper-mercury was antagonistic, and the other mixtures were additive to antagonistic. All mixtures became synergistic at or above median lethal concentrations. (Brambley-SRC)

W81-03998

AN ANALYTICAL METHOD FOR ASSESSING THE QUALITY, BY MICROBIAL EVALUATION, OF AQUEOUS EFFLUENTS OBTAINED FROM AN IN SITU OIL SHALE PROCESS.

Wyoming Univ., Laramie. Plant Sciences Div.

W. K. Gauger, S. E. Williams, D. S. Farrier, and J. C. Adams.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche.

Waste Treatment Processes—Group 5D

In: Oil Shale Symposium: Sampling, Analysis and Quality Assurance, Mar 26-28, '79, Denver, CO. EPA Rept EPA-600/9-80-022, Jun 80, p 535-545, 5 Fig, 18 Ref. EY-77-C-04-3913, EY-77-S-03-1761.

Descriptors: *Seawage bacteria, *Oil Shale, *Process water, *Growth, Monitoring, Effluents, Hydrocarbons, Bioassay, Metabolism, Evaluation, Environmental effects.

An analytical method was developed for the enumeration of microorganisms which grow in waste waters derived from an *in situ* oil shale processing experiment (Omega-9 retort water). This water is high in hydrocarbon components which may be inimical in the environment, but subject to degradation by microorganisms. Retort water agar, plate count agar, modified Henrici agar, K. F. agar, MRC broth and M-Endo broth were prepared, and inoculated with filtered sewage effluent, and turbid, and filter-sterilized Omega-9 water. Natural microorganisms grew rapidly in Omega-9 retort water, but did not grow on the coliform or streptococci enumeration media. The sewage microorganisms did not grow well on retort water agar. The original constituents of the retort water are altered as a result of microbial growth since the water provided the sole carbon and energy sources. When coupled with plate count agar or Henrici agar, the retort water agar constitutes an analytical method for evaluating the effects of retort water on soil microbial populations. (Brambley-SRC). W81-03999

TOXIC SUBSTANCES MONITORING PROGRAM, 1979,

California State Dept. of Fish and Game, Sacramento. Fish and Wildlife Water Pollution Control Lab.

K. McClenaghan, M. Meinz, N. Morgan, D. Crane, and W. Castle.

California State Water Resources Control Board, Sacramento. Water Quality Monitoring Report No 80-6, May, 1980, 63 p, 16 Fig, 19 Tab, 13 Ref.

Descriptors: *California, *Stream pollution, *Industrial wastes, *Farm wastes, *Toxicity, Streams, Bioindicators, Pesticide toxicity, Monitoring, Organic compounds, Trace metals, Heavy metals, Animal tissues.

Since 1976, the California State Water Resources Control Board and the Department of Fish and Game have operated a statewide screening program of toxic substances in freshwater organisms. During 1979, Fish and invertebrate organisms (clams and crayfish) from 28 state streams were collected and analyzed for selected trace metals and synthetic organic compounds. The streams (Primary Network) were chosen on the basis of their importance to the state. The flesh of bivalve mollusks or crayfish tailflesh and fish livers were analyzed for important metals including arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc; fish flesh was analyzed for mercury. In addition, both invertebrate and fish flesh samples were analyzed for 55 synthetic organic compounds, most of which are pesticides. The biota of some streams had concentrations of mercury, chlordane, DDT and its metabolites, toxaphene, and polychlorinated biphenyls (PCBs) that exceeded recommended guidelines for protection of fish and wildlife. The U.S. Food and Drug Administration establishes tolerance levels for toxic substances in animal tissues to be consumed by humans. None of the 1979 samples exceeded these levels. (Garrison-Omniplan) W81-04026

TOXICITY OF DISSOLVED OZONE TO FISH EGGS AND LARVAE,

Massachusetts Univ., Waltham. Dept. of Environmental Sciences.

C. Asbury, and R. Coler. Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1990-1996, July, 1980. 1 Fig, 2 Tab, 30 Ref.

Descriptors: *Toxicity, *Ozone, *Fish eggs, Bioassay, Eggs, Fish, Larvae, Life cycles, Disinfection, Ozonation, Water quality standards, Fish con-

trol agents, Fish management, Partial diversion, Connecticut River.

A proposal to divert a portion of the Connecticut River flow into the Quabbin, a reservoir for the Boston, Massachusetts, metropolitan area, raised concerns about possible inadvertent introduction of exotic fish species into the Quabbin. The injection of ozone was proposed as a rapidly degradable toxicant that would destroy entrained fish during transit to the Quabbin without compromising either the biotic community or public health. To find levels of dissolved residual ozone lethal to fish eggs and larvae during brief exposures, continuous flow toxicity tests were performed with eggs and larvae of yellow perch and fathead minnow, with eggs of white sucker, and with larvae of bluegill sunfish. The 50 and 99 percent lethal concentrations with confidence limits were calculated. Eggs of the species tested were more tolerant than larvae, which were destroyed by very brief exposures (less than 2 minutes) to residuals less than 0.1 milligrams per liter. Because of the sensitivity of larvae, residuals less than 0.1 milligrams per liter. Because of the sensitivity of larvae, residual ozone concentrations in natural waters should remain well below 50 micrograms per liter. (Carroll-FRC) W81-04176

TOXICS—TRUTH AND CONSEQUENCES,
For primary bibliographic entry see Field 5G.
W81-04179

MICROBIOLOGICAL MONITORING OF POLLUTION IN SHELLFISH FROM THE NEAPOLITAN AREA,

Istituto Superiore di Sanita, Rome (Italy). L. Volterra, F. A. Aulicino, E. Tosti, and M. Zicarelli.

Progress in Water Technology, Vol 12, No 4, p 553-577, 1980. 1 Fig, 6 Tab.

Descriptors: *Shellfish, *Bacterial analysis, *Coliforms, Commercial shellfishing, Water analysis, Public health, *Naples, Italy.

The microbiological quality of shellfish in the Neapolitan area was evaluated. Consumption of this low cost protein source is very popular during the spring and summer. Since shellfish are filter feeder organisms, they are one of the main sources of enteric disease in the region. Shellfish samples were collected in polluted and non-polluted waters and were purchased from a public market. All samples were tested for coliforms, *E. coli*, fecal streptococci, and total bacterial counts. Water samples were also analyzed. Marked differences were not found between the samples collected in polluted water and the samples collected in non-polluted water. This suggests that the local currents may draw suspended matter and bacteria from one side of the bay to another. The concentration of bacteria in shellfish was higher in the summer months, and the water was found to exceed Italian standards for *E. coli* in summer. Total coliforms and fecal coliforms were well related when correlation indices were calculated. The intervalue liquid of the shellfish was also examined. This data may be relevant when shellfish are used as biological indicators of pollution phenomena. (Small-FRC) W81-04204

THE EFFECT OF ELEVATED TEMPERATURE AND REACTOR SHUTDOWN ON THE BENTHIC MARINE FLORA OF THE MILLSTONE THERMAL QUARRY, CONNECTICUT, Trinity Coll., Hartford, CT. Dept. of Biology. C. W. Schneider.

Journal of Thermal Biology, Vol 6, No 1, p 1-6, 1981. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Marine algae, *Thermal pollution, *Thermal stress, Temperature effects, Algae, Ecosystems, Marine plants, Aquatic plants, Benthic flora, Flora, Long Island Sound, Connecticut, Cooling water, *Nuclear powerplants, *Millstone Thermal Quarry.

Increasing global industrialization, and particularly the proliferation of nuclear power plants, has in-

creased the exposure of numerous aquatic environments to unnaturally elevated temperatures. Although much is known concerning the physiological effects of temperature on a variety of organisms, far less is known about thermal effects on communities and populations, and particularly populations and communities of aquatic plants. The effects of elevated temperature variations on the benthic marine flora in a thermal sea water quarry where temperatures averaged about 10°C above the ambient Long Island Sound intake water were investigated. Forty-nine species and one variety of benthic blue-green, red, brown, and green algae were found in the quarry over a 1.5 year period. Of these, 58 percent can survive temperatures exceeding 30°C, but only six show survival after prolonged excessive temperature. At temperatures less than 27°C, the number of taxa is independent of temperature, but at greater temperatures there is a significant negative correlation of temperature to taxa count. The fewest taxa collected, three, were found each year after prolonged periods of temperatures above 30°C. Rapid drops in temperature due to reactor shutdown caused concomitant drops in taxa counts, with 14 percent of this variation attributed to drastic temperature change affecting the algae. (Carroll-FRC) W81-04230

STUDIES ON THE WATER-BLOOMS IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Ibaraki (Japan). Water and Soil Environment Div. R. Sudo.

Japanese Journal of Limnology, Vol 41, No 3, p 124-131, July, 1980. 11 Fig, 13 Ref.

Descriptors: *Eutrophication, *Lakes, Algal growth, Microcystis, Cyanophyta, Water quality, *Lake Kasumigaura, Japan, Nutrients, Phosphorus compounds, Nitrogen compounds, Light intensity.

Algal blooms and water quality in the hypereutrophic Lake Kasumigaura were examined. Microcystis isolated from the lake grew optimally at 30-35°C and at a light intensity of 500-1000 lux. Conversion rates from phosphorus or nitrogen to biomass (dry weight) of Microcystis were 950 mg cell per mg P and 55 mg cell per mg N. Intracellular P concentrations varied considerably during batch culture and influenced the rate of phosphorus uptake in the cells. Addition of N to lake water samples enhanced algal growth potential using *M. aeruginosa* and *Sphaerotilus capricornutum* as test algae. Quality of the surface water, measured June-August 1979, was as follows: water temperature, 22.8-30.5°C; pH, 7.2-9.6; transparency, 0.25-1.0 meters; COD, 3.7-8.2 mg per liter; total N, 1.09-5.73 mg per liter; ammonium-N, 0.038 mg per liter; nitrate-nitrite-N, 0.1-1.4 mg per liter; total P, 0.06-0.35 mg per liter; suspended solids, 8.9-100.6 mg per liter; and chlorophyll a, 7.8-268.0 mg per liter. (Cassar-FRC) W81-04293

METABOLISM OF BIOELEMENTS IN THE MINAMI-ASAOKAWA RIVER AND HUMAN ACTIVITIES AFFECTING IT,
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.

For primary bibliographic entry see Field 5B. W81-04294

SOME PROBLEMS ON THE PRESERVATION OF ESTUARY WITH SPECIAL REFERENCE TO ECOLOGY OF GAMO-LAGOON,
Tohoku Univ., Sendai (Japan). Faculty of Science. For primary bibliographic entry see Field 2L. W81-04295

5D. Waste Treatment Processes

STABILIZATION CHARACTERISTICS OF DEPOSITS OF BIOLOGIC SOLIDS GENERATED IN AERATED LAGOONS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

L. G. Rich.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224297, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Res. Inst. Clemson Univ. Tech. Rep. No. 92, March, 1981. 30 p, 6 Fig, 9 Tab, 2 Ref. OWRT-B-123-SC(1), 14-34-0001-9131.

Descriptors: *Aerated lagoons, *Benthic environment, *Suspended solids, Testing procedures, *Water quality management, Water quality, Lagoons, Aeration, Biochemical oxygen demand, Environment, Biomass, Benthos, Oxidation lagoons, Sedimentation, Solids, Water analysis, Biological oxidation, Laboratories, Ponds, Waste water, Waste water treatment.

Properly-designed dual-power-level multicellular lagoon systems should discharge effluents low both in suspended solids and biochemical oxygen demand. Solids that settle form deposits in which bio-degradable materials decompose in a benthal environment. The present laboratory study investigated the rates of benthal stabilization, and was unique in that it was conducted on a deposit formed at the bottom of an aerated water column that was primarily organic under conditions in which aerated lagoon solids were added on a semi-continuous basis. Such studies were needed to develop criteria for the sizing of lagoon cells and the specification of aeration equipment. It was concluded that: (a) aerated lagoon solids having little/no algae can be almost completely stabilized at 15-17 degrees Centigrade and at loading rates not exceeding 57 g biomass/sq. meter-days; (b) a year-old benthal deposit will have three percent solids; (c) benthal oxygen requirement of a deposit formed under similar loading and temperature conditions will be about 77 g oxygen/sq. meter-days. A method was described wherein the study results are applied to the design of a facultative aerated lagoon cell. (Zielinski-IPRA) W81-03951

URBAN SNOWMELT-CHARACTERISTICS AND TREATMENT,
Colorado Univ., at Boulder. Dept of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 5B.
W81-03952

FERRATE(VI) OXIDATION OF NITRILOTRIACETIC ACID,
Nebraska Univ., Lincoln. Dept. of Chemistry.
J. D. Carr, P. B. Keltner, and A. T., Erickson, III.
Environmental Science and Technology, Vol 15, No 2, p 184-187, February, 1981. 5 Fig, 3 Tab, 21 Ref. PWRT-A-053-NEB(2).

Descriptors: *Oxidation, *Nitritotriacetic acid. *Detergents, *Waste water treatment, nitrogen Compounds, Organic compounds, Chemical reactions, Potassium ferrate. Domestic wastes.

Nitritotriacetic acid, a builder in synthetic detergents, and its decomposition products are suspected of carcinogenicity. Its reactions with potassium ferrate were studied as a means of removing the contaminants from waste waters. The primary and secondary substituted amines (imino diacetic acid, glycine, and sarcosine) are oxidized 50 times faster than the tertiary amines (nitritotriacetic acid, methyl iminodiacetic acid, and dimethyl glycine). Therefore, the site of oxidation by ferrate was the N-C bond of each substrate. The intermediates may be further oxidized to form ammonia or methyl amines. (Cassar-FRC) W81-03954

MANGANESE REMOVAL FROM WATER BY PRECIPITATE FLOTATION TECHNIQUE,
Rhode Island Univ., Kingston. Dept. of Chemical Engineering.

O. J. Gregory, S. M. Barnett, and F. J. DeLuise. Separation Science and Technology, Vol 15, No 8, p 1499-1512, 1980. 7 Fig, 1 Tab, 12 Ref. OWRT-A-067-RJ(2), 14-34-001-9042.

Descriptors: *Separation techniques, *Manganese, *Flotation, Trace elements, Froth flotation,

Metals, *Waste water treatment, Water purification, Water treatment, Coagulation, Chemical reactions, Surfactants.

Trace amounts of manganese (2-5 mg per liter) were removed from dilute aqueous solution using a continuous countercurrent microgas dispersion technique, which may be applied to waste water treatment of water purification. After addition of sodium hypochlorite (5 times the theoretical requirement) to oxidize the Mn, microbubbles of air were applied in a flotation process. Although batch processes removed over 90% of the Mn, the countercurrent processes achieved 98% removal, to a final concentration of 0.06 mg per liter. The process was dependent on pH and type of surfactant. Most efficient removal was achieved in the pH range 8-12, using an anionic surfactant, dodecylbenzene sodium sulfonate. Mass transfer had a linear dependence on flow rate, suggesting that transfer occurs via an impingement mechanism, the bubbles forming a coherent matrix simulating a moving filter bed rising through the column. The apparatus treated up to 2.3 liters per min in a 23 cm active column length. Mathematical comparisons of a 1 cu ft column of microgas and a 1 cu ft diatomaceous earth filter with 30 psi pressure drop showed process rates of 14.9 liters per min and 4 liters per min, respectively. (Cassar-FRC) W81-03958

COSTS FOR WASTEWATER TREATMENT,
Environmental Protection Agency, Chicago, IL. Region V.

J. A. Hanlon.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sept., 80, Chicago, IL. EPA Report EPA-905/9-80-009, Sept., 80. p 81-86, 2 Tab. W81-04000

Descriptors: *Municipal wastes, *Waste water treatment, *Costs, *Waste water facilities, *Legislation, *Grants, Future planning, Construction, Community development, Cost sharing, Cost allocation, Pricing, Economic impact.

The Federal Water Pollution Control Act of 1972 established a system of Federal grants to municipalities for the construction of waste treatment facilities with the requirement that each recipient of treatment services pay its proportionate share of the cost of operation and maintenance, including replacement. Through fiscal 1980, \$25.7 billion dollars had been awarded in 18,000 individual grant awards, approximately 45% of them to communities with populations of less than 3500. The grant process was seen to be working well, but the cost impact on the small communities was large. The costs per household in small communities ranged from 2-6 times the cost in larger communities with pre-existing waste treatment systems. Attempts have been made to reduce the high costs for small communities by ensuring thorough analysis of anticipated costs of all treatment options, providing funding for upgrading or replacement of on-site treatment systems and encouraging energy conservation and reuse of resources. Studies are under way to identify where the construction grant program should be in 1990, with emphasis on the long-term economic self-sufficiency of the publicly owned treatment works. (Brambley-SRC) W81-03969

THE VARIETY OF ON-SITE TREATMENT SYSTEM FAILURE,
Environmental Protection Agency, Chicago, IL. Water Div.

For primary bibliographic entry see Field 5B.
W81-03975

HAZARDOUS WASTE CONCENTRATION TECHNOLOGIES,
Touhill, Shuckrow and Associates, Inc. Pittsburgh, PA.

A. J. Shuckrow, A. P. Pajak, and C. J. Touhill. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-175094, Price codes: A99 for paper copy, A01 in microfiche. In: Treatment of Hazardous Waste; Proceedings of the 6th Annual Research Symposium, Mar 17-20, 80, Chicago, IL. EPA Report EPA-600/9-80-011, Mar 80. p 50-61, 1 Fig, 4 Tab, 2 Ref.

Descriptors: *Waste water treatment, *Hazardous materials, *Waste water composition, Inorganic compounds, Organic compounds, Industrial wastes, Adsorption, Biological treatment, Chemical treatment, Chemical coagulation, Leachates.

An ongoing program is being conducted to evaluate and verify several selected concentration techniques for hazardous constituents of aqueous waste streams. Unit processes for concentrating hazardous constituents and the composition of waste streams to which the processes could be applied have been identified. Based on high, medium, and low concentrations of hazardous inorganic and hazardous organic constituents, a matrix was developed to categorize wastes in 27 waste streams. Most were in the two categories high organic-low inorganic and low organic-high inorganic. Three wastes were selected for bench-scale studies. They were a high organic-low inorganic, high organic-medium inorganic, and a synthetic leachate. For the first waste, the processes which seem most applicable are: carbon sorption, resin sorption, biological, stripping, and chemical coagulation/precipitation, although no one technique is sufficient, and they will have to be used in combination. (Brambley-SRC). W81-04000

ULTRAVIOLET DISINFECTION OF MUNICIPAL WASTE EFFLUENTS.

Texas A and M Univ., College Station.

A. C. Petrasek, Jr., H. W. Wolf, S. E. Esmond, and D. C. Andrews.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-11049, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-102, August 1980. 282 p, 139 Fig, 61 Tab, 15 Ref.

Descriptors: *Municipal waste water, *Ultraviolet radiation, *Disinfection, *Waste water treatment, *Viruses, *Coliforms, Irradiation, Effluents, Bacteriophage, Bacteria.

Ultraviolet (UV) light is evaluated as a potential candidate for replacing chlorine as a waste water effluent disinfectant. Two different UV exposure and irradiation systems were studied. The Kelly-Purdy Unit consisted of a shallow-tray exposure chamber with 13 UV lamps mounted horizontally 10 cm above the bottom of the chamber. This unit was operated under varying conditions of both flow and depth and generally provided inadequate disinfection, although fecal coliform densities were usually reduced by approximately three logs. The second UV system used during the project was the Model EP-50 manufactured by Ultraviolet Purification Systems, Inc. This exposure chamber consisted of a stainless steel pressure vessel with nine UV lamps running longitudinally through the chamber. Each lamp was isolated from the effluent being disinfected by a quartz sleeve. The disinfection observed on any given run was shown to be a function of the UV dose, and greater than four log reductions in fecal coliform densities were observed at times. During this project three special virus studies were conducted. The influent to the EP-50 was seeded with a F2 coliphage and an attenuated Type I poliovirus. During the three virus runs, viral and phage densities in the influent and effluent of the UV irradiation chamber were monitored. The observed reductions in viruses were correlated with UV doses, and the F2 coliphage response to the UV disinfection process was similar to the response of the Type I poliovirus. (Moore-SRC). W81-04001

HAZARDOUS MATERIAL SPILLS AND RESPONSES FOR MUNICIPALITIES,
Allegheny County Sanitary Authority, Pittsburgh, PA.

G. A. Brinsko, F. J. Erny, E. J. Martin, A. P.

Waste Treatment Processes—Group 5D

Pajak, and D. M. Jordan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-214141, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-108, July 1980. 285 p, 33 Fig, 49 Tab, 38 Ref, 12 Append.

Descriptors: *Hazardous materials, *Secondary waste water treatment, *Waste water facilities, Heavy metals, Pilot plants, Monitoring, Effluents, Degradation, Prevention, Accidents, Spills, *Allegheny County, Pennsylvania.

This project deals with the Allegheny County Sanitary Authority (ALCOSAN) efforts to develop and implement a comprehensive program to minimize potential adverse effects of hazardous material spills on the ALCOSAN waste water collection and treatment system. Principal areas reported are: a compendium of the effects that hazardous materials (particularly heavy metals) can have on secondary treatment; inventory of hazardous materials stored within the ALCOSAN service area; evaluation of 10 selected hazardous materials in a pilot plant simulating the effects of spills on treatment plant performance; study of the potential for a monitoring and surveillance system at the head-end of the plant and key locations within the collection systems; development of a contingency plan to initiate countermeasures in the event of a spill; and investigation of surcharge, financing, and legislative programs. The pilot plant results showed that the hazardous materials had minor adverse effects upon the plant operation. Heavy metal removal was most effective for lead, and in declining order, copper, chromium, zinc, cadmium, and nickel. However, operational problems and degradation of effluent quality illustrate the potential adverse effects of hazardous materials upon the operation of the full-scale facility. (Bramley-SRC). W81-04008

MONITORING SEPTAGE ADDITION TO WASTE WATER TREATMENT PLANTS; VOLUME II. VACUUM FILTRATION OF SEPTAGE,

Lowell Univ, MA.

C. R. Ott, and B. A. Segall.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-142663, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-112, August 1980. 156 p, 13 Fig, 84 Tab, 7 Ref, 4 Append.

Descriptors: *Waste water treatment, *Sludge drying, *Sludge conditioning, *Vacuum filtration, *Septic sludge, Activated sludge, Sludge filters, Field tests, Sludge cake, Cost analysis, Water treatment facilities.

The study examined the feasibility of using conventional vacuum filtration to dewater conditioned septage sludge, by itself and in combination with thickened waste activated sludge. The septage was conditioned with aluminum sulfate, ferric chloride and sulfuric acid, each used independently. Laboratory experiments were conducted with a filter leaf apparatus that simulates a coil spring vacuum filter. The Capillary Suction Test was used to estimate filterability. Field studies, utilizing a full-scale vacuum filter and large quantities of septage, were conducted at the Medfield, Massachusetts, waste water treatment plant. The studies showed that vacuum filtration of a combined mixture of thickened waste activated sludge and septage conditioned with either alum, ferric chloride or acid is feasible. Excellent cake yields and filtrate quality were obtained. The cost of treating septage in the solids handling train at Medfield was less than the cost of adding septage to the liquid stream at the plant inlet. (Author's abstract). W81-04009

CONVERTING ROCK TRICKLING FILTERS TO PLASTIC MEDIA; DESIGN AND PERFORMANCE,

Brown and Caldwell, Walnut Creek, CA.
R. J. Stenquist, and K. A. Kelly.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119885, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-120, August 1980. 191 p, 53 Fig, 29 Tab, 36 Ref, 5 Append.

Descriptors: *Plastics, *Secondary waste water treatment, *Filtration, *Trickling filters, *Waste water facilities, Oxidation, Nitrification, Biological oxygen demand, Nitrogen removal, Suspended solids, Volatile solids, Costs, Performance evaluation.

The objectives of the investigation were to review the conversion of trickling filters at the Stockton, California, Regional Waste water Control Facility from rock media to plastic media, and to develop general design considerations for similar conversions which might be carried out elsewhere. The Stockton plastic trickling filters are designed to operate in two modes: to oxidize carbonaceous material during the canning season when plant loadings are high (58 mgd); and to provide combined carbon oxidation-nitrification during the noncanning season when loadings are low (23 mgd). Over a 1 yr. sampling period BOD5 levels in effluent were about 20 mg/l (90% removal), ammonia nitrogen averaged less than 3 mg/l (80-90% nitrification), the suspended solids were above the 30 mg/l limit for three of the noncanning months and the three canning months, and total secondary volatile solids production averaged 0.43 kg/kg COD removed and 0.67 kg/kg BOD5 removed. Operational changes were made which improved BOD5 removal and nitrification. The total construction cost was \$3,953,000 and operating and maintenance costs were \$1,323,000 in 1975-76. Based on information developed from this project and from review of other plastic media trickling filter plants, manufacturers' data, and technical literature, general design considerations are developed for replacing rock media with plastic media, including both process and physical design. (Bramley-SRC). W81-04011

CYANIDE REMOVAL FROM REFINERY WASTE WATER USING POWDERED ACTIVATED CARBON,

IIT Research Inst, Chicago, IL.

J. E. Huff, and J. M. Bigger.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-211469, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-125, May 1980. 109 p, 24 Fig, 32 Tab, 21 Ref, 1 Append.

Descriptors: *Oil refineries, *Cyanide, *Waste water treatment, *Activated carbon, Adsorption, Oxidation, Copper chloride, Organic compounds, Cost analysis, Activated sludge process, Effluents, Industrial wastes, Refineries.

This research was initiated to investigate the feasibility of utilizing powdered activated carbon (PAC) and cupric chloride for removal of cyanide in refinery waste waters. Batch tests and continuous tests were conducted to determine the basic chemistry and cyanide removal efficiency of the adsorption and catalytic oxidation of cyanide by PAC and cupric chloride. In the first phase the operating variables of pH, copper dosage, mode of copper addition, carbon dosage, and type of carbon were investigated. A pH near neutral (pH 6-8.5) was desirable to obtain low equilibrium cyanide in the aqueous phase while maintaining a low copper level. Cyanide removal, greater than 95%, was readily achieved in the batch tests using 250 mg/l of powdered carbon and 1.0 to 1.5 mg/l of copper on solutions containing 0.5 mg/l iron cyanide. Continuous tests were conducted using two laboratory scale activated sludge units and actual refinery waste water. Both carbon and copper were added to the aeration basin, and the organic removal as well as cyanide removal performance was monitored. The continuous tests revealed that cyanide can be successfully removed through the addition of PAC and cupric chloride into an activated sludge unit. The biological efficiency did not indicate any detrimental effects from the copper

addition (with the exception of the first test where the aeration basin was slug-dosed). More carbon is required than predicted in the batch tests due to the organics competing with cyanide for the active sites on the carbon. An economic evaluation indicated that this process requires little or no capital expenditure and should provide many refineries with an economic approach for reducing effluent cyanide concentrations. (Bramley-SRC) W81-04012

PHOSPHORUS REMOVAL IN LOWER GREAT LAKES MUNICIPAL TREATMENT PLANTS,

Clarkson Coll. of Techology, Potsdam, NY. Dept. of Civil and Environmental Engineering. J. V. DePinto, J. K. Edzwald, M. S. Switzelbaum, and T. C. Young.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144479, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-117, August, 1980. 161 p, 47 Fig, 36 Tab, 32 Ref, 3 Append.

Descriptors: *Phosphorus removal, *Waste water treatment, *Water pollution control, Water pollution sources, Municipal waste water, Great Lakes, Effluents, Cost analysis, Pollution load, Eutrophication, Water treatment facilities.

The Great Lakes Water Quality Agreement of 1978 called for the achievement of 0.5 mg/l total phosphorus as the maximum effluent level in all Lake Erie and Ontario municipal treatment plants discharging greater than one million gallons per day. A survey of phosphorus treatment approaches and accomplishments was carried out for all lower Great Lakes basin plants with flows greater than 1 million gallons per day. Field operation monitoring studies were carried out to evaluate the performance of four municipal treatment plants practicing phosphorus removal, including a determination of the bioavailability of the waste water phosphorus. Costs were analyzed at each of the four plants monitored, including incremental costs to achieve a 0.5 mg/l standard. Of the 229 plants in this survey, 52% are achieving an effluent total phosphorus concentration of 1.0 mg/l, while only 8.3% (19 plants) are meeting a 0.5 mg/l standard. If all plants in the Lake Erie basin not currently achieving a 1.0 mg/l standard were to do so, the municipal load would be reduced by 2165 MT/yr. A standard of 0.5 mg/l met in the Lake Erie basin would reduce the current load by 3264 MT/yr. Similar standards achieved in the Lake Ontario basin would reduce municipal loads by 1450 and 2085 MT/yr, respectively. Combining all bioavailability assays revealed on average of 72% of the total P was available for uptake, with 55% of the particulate fraction and 82% of the total soluble fraction available. (Moore-SRC) W81-04013

REVIEW OF ALTERNATIVES FOR EVALUATION OF SEWER FLUSHING; DORCHESTER AREA - BOSTON,

Bogert (Clinton) Associates, Fort Lee, NJ.

H. L. Kaufman, and F. Lai.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-142648, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-118, August, 1980. 99 p, 24 Fig, 25 Tab, 22 Ref.

Descriptors: *Water pollution control, *Sewer systems, *Combined sewer overflows, *Flushing, Computer models, Simulation analysis, Model studies, Storm waste water, Waste storage, Biochemical oxygen demand, Suspended solids, Storm runoff, Waste water treatment, Cost-benefit analysis.

Alternatives employing sewer flushing were developed for the Dorchester Area of Boston, Massachusetts, and their cost effectiveness compared with the decentralized combined sewer overflow (CSO) storage/treatment and disinfection facilities proposed as Eastern Massachusetts Metropolitan Area (EMMA) Alternative 1. Alternatives evaluated included sewer flushing, offline storage, in-pipe

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

storage, storage/treatment facilities, and a combination of the above. Continuous simulation runs using 16 years (1960-1975) of hourly rainfall data from May through November were made to determine the level of CSO pollution control obtained. The STORM program was modified to include continuous simulation of solids and organic material deposited in sewers during dry days, the removal of those deposits by dry day sewer flushing and wet-weather flow, and the storage and treatment effects of a CSO storage/treatment facility on the wet-weather discharge. STORM was also modified to do continuous simulation over a part year period instead of the entire year to allow flexibility for water quality study in areas where the recreational season may be of concern. The CSO storage/treatment facility, proposed as EMMA Alternative 1 designed for a one-year storm, would remove about 50% of the BOD and suspended solids in the CSO and is the highest cost alternative of all considered. The capacity of the conveyance and pumping facilities in the original plan can be reduced by 80% and cost reduced by about half while maintaining the same level of pollution control. Sewer flushing can be an adjunct to, but can not substitute for, structural alternatives. Use of storage available in large sewers in conjunction with sewer flushing could reduce the cost to about 7% that of EMMA Alternative 1. For all alternatives considered, BOD removals equal to those of EMMA Alternative 1 could be achieved at less cost than equal SS removals. (Moore-SRC) W81-04014

WASTE WATER CONTAMINATE REMOVAL FOR GROUNDWATER RECHARGE AT WATER FACTORY 21,

Stanford Univ., CA. Dept. of Civil Engineering. P. L. McCarty, M. Reinhard, J. Graydon, J. Schreiner, and K. Sutherland.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-107088, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-114, August, 1980. 164 p, 32 Fig, 35 Tab, 13 Ref, 7 Append.

Descriptors: *Advanced waste water treatment, *Water quality, *Groundwater recharge, *Waste water renovation, Municipal waste water, Saline water barriers, Biological treatment, Injection wells, Reverse osmosis, Chlorination, Viruses, Activated sludge process, Organic compounds, Orange County (California).

Water Factory 21 (WF-21) in Orange County, California, is a 0.66 cu m/s advanced waste water treatment plant designed to reclaim biologically treated municipal waste water to supply the injection water for a seawater-barrier system. Processes included are lime treatment, air stripping, filtration, activated-carbon adsorption, reverse osmosis, and chlorination. An evaluation of the second 1 1/2 yr of operation of the plant indicates that the change in influent water from a trickling filter to an activated sludge treated waste water with less industrial waste contribution has resulted in more economical plant operation. The total treatment system through reverse osmosis produces a water with an effluent COD averaging less than 2 mg/l and a total organic carbon of less than 1 mg/l. Enteric viruses are prevalent in influent waters to WF-21, but are effectively removed by treatment. WF-21 has a high reliability for producing a water with contaminant levels below those set forth in current and proposed EPA National Interim Primary and Secondary Drinking Water Standards. Reverse osmosis demineralization was effective in reducing the mineral content of the reclaimed water sufficiently to satisfy the proposed National Secondary Drinking Water Criteria. Treated water is greatly improved in quality over influent water; however, trace organics can still be detected. Many of the trace organics found in the effluent appear to be the result of chlorination for disinfection. (Moore-SRC) W81-04015

EVALUATION WASTE WATER DISINFECTION ALTERNATIVES,

Ontario Ministry of the Environment, Toronto.

F. A. Tonelli, K. W. A. Ho, and N. W. Schmidtke. Research Program for the Abatement of Municipal Pollution Within the Provisions of the Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No 106, 1981. 173 p, 35 Fig, 50 Tab, 7 Ref, 7 Append.

Descriptors: *Waste water treatment, *Chlorination, *Chemical treatment, *Cost-benefit analysis, Municipal waste water, Disinfection, Ozonation, Oxidation, Toxicity, Waste water purification, Oxidation process, Waste water oxidation, Waste water, Sanitary waste water, Water treatment, Ozone, Oxidized waste water, Water quality, Water quality control, Water quality management, Cost analysis.

Studies were undertaken at small scale on three waste water effluent types (non-nitrified, nitrified under field conditions to compare chlorine, chlorine dioxide, and ozone as terminal disinfectants for municipal waste water treatment plant effluents. All three disinfectants reduced total effluent conforms to the selected target levels (2000 total effluent forms/milliliter). Averaged disinfectant dosages and minimum contact times needed to consistently achieve target levels, and their effectiveness for controlling fecal coliforms, fecal streptococci, Pseudomonas aeruginosa and salmonellae were determined. Field and engineering study results were used to develop use-costs, for which chlorine had the lowest projected use-cost at all design capacities examined. Improved effluent quality and larger treatment plant size made ozone more economical than chlorine dioxide. Dechlorination can eliminate acute toxicity of chlorinated waste waters. Ozonation gave non-acute toxicity effluents and should be considered for high quality effluent disinfection, especially at oxygen-activated sludge plants. Chlorine dioxide was considered economically unattractive due to its toxicity to juvenile rainbow trout and the need for residual removal. (Zielinski-IPA) W81-04032

PROCESS FOR THE SELECTIVE EXTRACTION OF METAL CATIONS FROM AQUEOUS SOLUTIONS THEREOF AND COMPOSITIONS,

Berol Kemi A.B., Stenungsund (Sweden). (Assignee).

B. G. Karlsson. U.S. Patent No. 4,217,235, 6 p, 3 Tab, 6 Ref, Official Gazette of the United States Patent Office, Vol 992, No 2, p 618, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Metals, Separation techniques, Chemical reactions, Phenols, Organic compounds.

A process for selectively extracting metals ions is provided which overcomes many of the difficulties of prior processes. In the process of the invention, an aqueous solution of the metal cations to be separated is extracted with a solution in a water-immiscible organic solvent of an ortho-N-substituted aminomethyl phenol which is insoluble in the aqueous solution. These compounds have the ability to selectively extract many toxic polyvalent metal cations from aqueous solution. The mechanism for this extractive capability is not known, but it is believed that the hydroxyl group and the amino nitrogen may link with the metal cation to form a chelate or complex, possibly including the cation as one ring atom of a six-membered ring. (Sinha-OEIS) W81-04082

SEWAGE DELIVERY AND FILTRATION SYSTEM,

Great Circle Associates, Walnut Creek, CA. (Assignee).

S. B. Mullerheim, and F. G. Williams, Jr. U.S. Patent No 4,217,219, 18 p, 14 Fig, 7 Ref, Official Gazette of the United States Patent Office, Vol 992, No 2, p 614, August 12, 1980.

Descriptors: *Patents, *Wastewater treatment, *Separation techniques, Filtration, Oxidation, Sludge treatment, Soil disposal fields.

A method and apparatus for treating wastewater such as sewage are disclosed. Designed principally for complete on-site wastewater treatment and disposal, the system separates wastewater into liquid wastes and solid wastes by filtration, treats the liquid wastes with a mild oxydizing agent and disperses them into unsaturated ground. The solid wastes are periodically removed, along with used portions of the paper filter medium and delivered, in the case of sewage, to a composting area where the still-fresh solids can be aerobically composted. Preferred and particularly advantageous embodiments of a filtering system, a sewage delivery system, a vacuum generating system, and a liquid level sensor, each of which may be used with the invention, are disclosed. (Sinha-EIS) W81-04084

PROCESS FOR FLOCCULATION USING CORSSLINKED POLYSULFONIUM COMPOUNDS,

American Cyanamid Co., Stamford, CT. (Assignee).

H. P. Panzer, A. T. Coscia, and A. G. Robustelli. U.S. Patent No 4,217,215, 4 p, 3 Tab, 4 Ref, Official Gazette of the United States Patent Office, Vol 992, No 2, p 612, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Water purification, Domestic wastes, Industrial wastes, Suspended solids, Flocculation, Polymers, Chlorine, Cationic polymers.

Cationic polymers that are water-soluble are useful in a variety of applications in which their cationicity is advantageous. This invention relates to a process for flocculating aqueous suspensions of solid materials wherein the flocculating agent employed is a water-soluble cross-linked cationic polysulfonium derivative of a poly(thiodiethanol)ether. These cationic polymers are effective flocculants for suspended particles and are used in applications involving river-water clarification and settling of solids in municipal and industrial wastes, iron ore slimes, fine coal slurries, enzyme mashes, and the like. The polymers used in the process are effective in applications involving chlorine as well as in applications where chlorine is not involved. The polymers are free of amine cationicity and thus offer effective alternatives to amine usage. (Sinha-OEIS) W81-04086

HIGH MOLECULAR WEIGHT POLYVINYLMINE HYDROCHLORIDE AS FLOCCULANT,

Dynapol, Palo Alto, CA. (Assignee).

P. L. Dubin. U.S. Patent No 4,217,214, 5 p, 2 Fig, 6 Tab, 5 Ref, Official Gazette of the United States Patent Office, Vol 992, No 2, p 612, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Water purification, Flocculation, Polymers, Separation techniques, Sludge treatment, High-molecular weight.

A primary object of the invention is to provide for the use of polyvinylamine hydrochloride as an effective flocculating agent having utility in a variety of water treatment systems. The high molecular weight polyvinylamine hydrochloride exhibits unexpectedly superior flocculation characteristics over its low molecular weight counterpart as well as other known flocculating agents and is readily adapted for use in conventional water treatment systems, including water clarification and sludge treatment. (Sinha-OEIS) W81-04087

METHOD OF PUMPING AND PROCESSING PHOSPHATE SLIME FOR LAND RECLAMATION,

T. M. Deal.

U.S. Patent No 4,217,212, 7 p, 6 Fig, 14 Ref, Official Gazette of the United States Patent Office, Vol 992, No 2, p 611-612, August 12, 1980.

Descriptors: *Patents, *Pollution abatement, *Dewatering, Settling basins, Soil contamination,

Waste Treatment Processes—Group 5D

Phosphates, Pumping, Mine water, Waste disposal, *Mine wastes, *Land reclamation, Phosphate mining, Phosphate slimes.

Mining natural phosphate rock has resulted in thousands of acres being wasted in the form of presently existing phosphate slime settling ponds which have defied drainage as well as use of the waste as land fill. This invention relates to a method capable of pumping such semi-liquids. In addition to making it possible to pump such material in commercial volumes, the method involves the further step of scrubbing or mixing the material in transit to modify the form of the slime so as to dewater it by seepage to a concentrate to be useable in land reclamation as a fill. Movement of the semi-liquid material between the immersed pump associated with a pressure chamber and the surface located transmission pump is boosted by a suitable water actuated venturi pump injection system which also serves to control the density or percentage of solids of the phosphate slime and water mixture. In order to modify the form of the slime to effect dewatering, the slime is mixed with scrubbing material in the form of water and an abrasive such as sand, sand tailings, lime tailings and the like, up stream from the transmission pump. The scrubbing and mixing action which takes place in the transmission pump and transit pipe modified and breaks down the physical make up of the slime to facilitate dewatering by seepage or the like. (Sinha-OEIS) W81-04088

PRESSURIZED TREATMENT OF SEWAGE,
BioMass Fuel Conversion Associates, Inc., Yuba City, CA. (Assignee).

T. H. Crane.

U.S. Patent No 4,217,211, 6 p, 2 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 610, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, Aerobic treatment, Mixing, Equipment, Activated sludge, Pressure, Subterranean shaft.

This invention is directed to an apparatus and process for improved sewage treatment utilizing a deep subterranean shaft as an aerobic digester vessel. The sewage is treated by passing it into a subterranean shaft to increase oxygen solubility by causing the liquor within the lower confines of the shaft to be continually recirculated and re-exposed to additional oxygen liquor being supplied to the pressurized regions of the shaft. Incorporated into the mixing shaft are liquor mixing nozzles. The descending sewage liquor passes downwardly through the mixing nozzles to the bottom of the subterranean shaft. It then ascends upwardly. The action of the descending liquor through the nozzles entrains ascending liquor back into the descending liquor. This recirculates the liquor in the bottom of the shaft allowing for extended contact time of the liquor with the microorganisms used in the liquor to aerobically digest the sewage. (Sinha-OEIS) W81-04089

PROCESS AND MEANS FOR BREAKING EMULSIONS,
Societe Anonyme dite: Technime S.A., Buchelay (France). (Assignee).

J. Heidenreich.

U.S. Patent No 4,217,210, 6 p, 1 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 611, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Emulsions, Suspension, Adsorption, Dispersions, Aluminium.

A process is described for breaking emulsions which can in particular be used in the purification of industrial sewage and which utilises special means, namely useful reagents comprising active earths and aluminium or an aluminium salt, whereby the active earths have been treated in such a way that their swelling in water is limited by the formation of microcrystals at their active sites. The process comprises the treatment of the emulsions

and suspensions to be treated under stirring, by means of a liquid reagent chosen from aqueous solutions and dispersions comprising: an adsorbent substance such as the bentonites and argillaceous and alkaline earths; and aluminium or an aluminium derivative, particularly $AlCl_3$, Al_2O_3 or $Al(OH)_3$. (Sinha-OEIS) W81-04090

PROCESS FOR REMOVING HEAVY METAL SULPHIDES FROM AQUEOUS SYSTEMS,

Bayer A.G., Leverkusen (Germany, F.R.). (Assignee).

G. Steffan, E. Borgmann, P. Buchel, and W. Harms.

U.S. Patent No 4,217,209, 10 p, 3 Tab, 9 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 610, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Chemical wastes, *Heavy metals, Separation techniques, Flocculation, Chemical reactions, Filtration, Polymers, Sulphides, *Product recovery.

The invention relates to a method for removing heavy metal sulphides from dilute aqueous systems as they are present in numerous chemical processes. The method is characterized in that water-soluble polymers such as polyethyleneimines, homopolymers or copolymers of derivatives of acrylic acid or methacrylic acid or homopolymers or copolymers of styrenesulphonic acids are added to the systems and the systems are then filtered. A filtration method which is technically advantageous, also with regard to the recovery of heavy metals, is to continuously filter off the mixture of a little filter aid and the coagulated heavy metal sulphide by means of a rotary filter to which a precoat layer of pure filter aid has been applied. With this method, the layer of heavy metal sulphide and a little filter aid is continuously removed with a doctor blade and recovered. (Sinha-OEIS) W81-04091

PROCESS FOR REGENERATING CONTAMINATED ACTIVATED CARBON,

Battelle Memorial Inst., Geneva (Switzerland). (Assignee).

D. Doniat, J.-M. Corajoud, J. Mosetti, and A. Porta.

U.S. Patent No 4,217,191, 7 p, 2 Tab, 2 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 605, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Activated carbon, Electrolysis, Oxidation, Organic wastes, Separation techniques, Electrolytes, *Regeneration.

It is a principal object of the invention to provide a new and improved process for regenerating activated carbon that has been used in purifying industrial and household waste waters and is to be reused in treatment of waste waters. Particles of activated carbon are suspended in an electrolyte. The resulting mixture is circulated through an electrolytic cell provided with a membrane or liquid-permeable partition defining two chambers in the interior of the cell to separate the cell into an anode chamber and a cathode chamber. The carbon-electrolyte mixture circulates through the anode chamber, and the fluid-permeable partition prevents carbon particles from entering the chamber containing the cathode but allows the electrolyte to flow through. Carbon particles contact the anode as they flow through the anode chamber, and while in contact with the anode, oxygen is liberated at their surface. This oxygen reacts with adsorbed impurities on the surface of the carbon particles to oxidize the impurities. The cell is provided with means for inducing turbulence in the carbon-electrolyte mixture to aid mixing of the carbon with the electrolyte and to help insure that all the carbon particles contact the anode. (Sinha-OEIS) W81-04093

THERMAL SYSTEM,
R. F. French.

U.S. Patent No 4,216,659, 7 p, 2 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 992 No 2, p 424, August 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Heat transfer, Heat exchangers, Domestic water, Domestic wastes, Heated water, Closed loop systems, Dehumidifiers.

A thermal system which simultaneously collects heat from waste water and from the dehumidification of a living space utilizes the heat thus collected to heat water. Transfer of heat is accomplished by a heat exchange medium circulating in a closed loop system. (Sinha-OEIS) W81-04095

WASTE WATER TREATMENT,
Water Research Centre, Marlow (England). (Assignee).

A. G. Boon, and H. R. S. Page.

U.S. Patent No 4,216,089, 6 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 219, August 5, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Gases, Oxygenation, Pressure, Odor, Safety.

Gases are dissolved in aqueous liquid and sludges by employing the preliminary step of subjecting the liquids to a reduced pressure to remove incidental gases dissolved or contained therein, and the oxidative treatment of surface waters, waste waters or sewage, in which the latter are first de-gassed before being oxygenated. The degassing can be effected by using a siphon. The step of removing gases will effect removal not only of 'inert' gases such as nitrogen, but also of noxious and malodorous gases such as hydrogen sulphide. The removal of such gases under controlled conditions is advantageous since it reduces corrosion and the risk of danger and inconvenience to personnel from the presence of those gases in the sewage and surrounding environment. (Sinha-OEIS) W81-04099

METHOD OF TREATING PHENOLIC WATERS FORMED IN THE MANUFACTURE OF PHENOL-FORMALDEHYDE RESINS,

A. M. Juferov, G. I. Shakova, and O. M. Nestorova.

U.S. Patent No 4,216,088, 4 p, 1 Tab, 5 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 219, August 5, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Water purification, Separation techniques, Phenols, Heating, Resins, Condensation, Formaldehydes.

The object of this invention to improve the degree of purification of phenolic waters is attained in a method of treatment of the waters formed in the manufacture of phenol-formaldehyde resins. It comprises the introduction of formaldehyde and the product of phenol-formaldehyde condensation, taken in a quantity of 15-25 parts by weight per 100 parts by weight of phenolic waters into the waters and heating them in the presence of alkali. The addition of the phenol-formaldehyde condensation product and the corresponding amount of formaldehyde ensures a considerable excess of formaldehyde toward free phenol and a high degree of purification from phenol. Moreover, the addition of the condensation product gives specific desired properties to the resin which is formed in the process of treatment of phenolic waters. (Sinha-OEIS) W81-04100

PROCESS FOR COMPLETE OR SELECTIVE REMOVAL OF SALTS FROM AQUEOUS SOLUTION,

For primary bibliographic entry see Field 3A.

W81-04101

IPCD'S MAY BE ALTERNATIVE TO CHLORINE,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Water/Engineering and Management, Vol 128, No 1, p 74-75, January, 1981.

Descriptors: *Water treatment, *Disinfection, *Portable water, Chlorination, Polymers, Resins, Bacteria, Microorganisms, Viruses, Insoluble polymeric contact disinfectants.

Insoluble polymeric contact disinfectants (IPCD's) may be useful as an economical, effective alternative to conventional chlorination of water. The water to be treated will contact an insoluble, polymeric biocide which will remove bacteria, viruses and other deleterious organisms. This particular group of quaternary ammonium compounds came under study due to their wide spectrum of antimicrobial activity, low mammalian toxicity and relative ease of synthesis. Preliminary testing of Resin 12 is underway. (Baker-FRC)
W81-04116

FULL-SCALE OZONE DISINFECTION OF WASTE WATER,
M and I, Inc., Fort Collins, CO.
K. L. Rakness, and B. A. Hegg.
Journal of the Water Pollution Control Federation, Vol 52, No 3, p 502-511, March, 1980. 7 Fig, 3 Tab, 5 Ref.

Descriptors: *Waste water treatment, *Ozone, *Operation and maintenance, Facilities, Water pollution control, Design criteria, Tourism, *Estes Park, Colorado.

The Upper Thompson Sanitation District ozone system, serving the area around Estes Park, Colorado, was one of the first full-scale ozone disinfection facilities in the United States when it began operation in 1976. The process uses air pretreatment equipment (air compressor, refrigerant dryer and drying towers), two air-fed ozone generators with a flow of 118 cu m per hr, and a 12-foot deep ozone contact basin divided into nine compartments to provide a serpentine vertical flow of waste water at a detention time of 14 min. Mechanical problems with various pieces of equipment resulted in moisture breakthrough, causing short circuiting and generator damage. High dewpoint detectors proved insufficient to prevent generator damage. The dewpoint of air in the drying towers gradually increased during each 8-hour operating cycle, causing a 25% decrease in ozone delivery; the dewpoint meter installed by the manufacturer failed to indicate this increase. The meter and the tower desiccant were replaced. The polyvinyl chloride ozone piping cracked after 1 yr and was replaced by stainless steel pipe with welded connections. Ozone transfer efficiency was less than design but consistent with theoretical ozone/liquid gas transfer considerations. Ozone did not dissipate quickly enough from contact basin off-gas. Disinfection was as good as or better than design (e.g., fewer than 200 fecal coliform/100 ml water at applied ozone dosages of 7 g/ml, with transfer efficiency of 50-60%). (Robinson-FRC)
W81-04120

MODELING OF THE KINETICS OF LIQUID PHASE OXIDATION OF PAPER INDUSTRY BLACK LIQUOR BY AIR. (MODELISATION DE LA CINETIQUE D'OXYDATION EN PHASE LIQUIDE DE LIQUEUR NOIRE DE PAPETERIE PAR L'OXYGENE DE L'AIR),
Institut National des Sciences Appliquées, Toulouse (France).
C. Pujo, B. Talayach, and J. Besomé-Vailhe.
Water Research, Vol 14, No 8, p 1055-1059, August, 1980. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Waste water oxidation, *Pulp and paper industry, *Kinetics, Chemical reactions, Industrial wastes, Chemical degradation.

The use of wet air oxidation was studied for the black liquor obtained from soda treatment in pulp manufacture, because the high oxygen demand and large silica content of these solutions prevent the use of classical treatments. The kinetics of the reaction were studied to determine the operating conditions under which physical transfer is minimized and total oxidation is favored. The agitation

speed had a determining effect on the degree of oxidation. For an oxidation temperature of 250°C and a total pressure of 135 bar, corresponding to an 8% excess of air in a reaction time of 2 hr, there were two domains: at an agitation speed of <300 rpm the degree of oxidation is a power function increasing with agitation speed, and the oxygen diffusion at the gas-liquid interface introduced a resistance to the transfer limiting the total speed of the reaction; at an agitation speed of >300 rpm the degree of oxidation is independent of agitation speed. Therefore, the speed should be >300 rpm to minimize physical resistance to transfer. For reaction temperatures of 220-320°C the partial pressure of oxygen had a slight influence on the kinetics, but did not determine the reaction rate. A model for the reaction rate and a power rate expression were developed to describe the oxidation of soda black liquor. (Hertzoff-FRC)
W81-04121

MECHANISM OF OZONIZATION OF HERBICIDES DERIVED FROM PHENOXYACETIC ACID: 2,4-D AND MCPA. (MECANISME DE L'OZONATION DES HERBICIDES DERIVES DE L'ACIDE PHENOXYACETIQUE: 2,4-D ET MCPA).

Poitiers Univ. (France). Lab. Chimie XI.
M. Dore, B. Legube, and B. Laglais.
Water Research, Vol 14, No. 7, p 767-773, July 1980. 10 Fig, 3 Tab, 20 Ref.

Descriptors: *Ozone, Herbicides, *Water treatment, Oxidation, Chemical reactions, Laboratory studies, Chemical degradation, MCPA, Phenoxyacetic acid.

The ozonation in aqueous solution of the widely used herbicides 2,4-D and MCPA and their reference substance phenoxyacetic acid was studied because of an interest in photooxidative degradation of herbicide residues and ozone disinfection of drinking and waste waters. The action of ozone on MCPA, 2,4-D and phenoxyacetic acid led to the total disappearance of these compounds, as indicated by high pressure liquid chromatography, gas chromatography and UV spectroscopy. In all cases, oxygenated aliphatic chains, probably acids, aldehydes and ketones, were formed. The accumulation of ozone in the reaction medium and the slight decrease in organic carbon content indicate the presence of products stable to ozone. For MCPA the low ozone consumption and the early appearance of a compound with an acetyl group are explained by direct opening of the aromatic ring by 1,3-dipolar cycloaddition of the ozone molecule, indicating that ozone can be used to degrade herbicides derived from phenoxyacetic acid. Ozonation was carried out in a column at concentrations of 22.1-30 mg/l to follow the ozonation reactions. (Hertzoff-FRC)
W81-04122

ANAEROBIC TREATMENT IN A SLUDGE BED SYSTEM COMPARED WITH A FILTER SYSTEM,

Swedish Water and Air Pollution Research Lab, Stockholm.
B. Frostell.
Journal of the Water Pollution Control Federation, Vol 53, No 2, p 216-222, February, 1981. 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Sludge filters, *Sludge bed, *Comparison studies, Filters, Waste water treatment, Suspended solids, Flocculation, Sedimentation, Effluents, Methane, Chemical oxygen demand, Organic loading, Hydraulic loading, Separation techniques, *Anaerobic treatment.

An anaerobic filter filled with a high-porosity (0.96) plastic material and an anaerobic sludge bed reactor equipped with a specially designed sludge separation system were compared in parallel experiments. The sludge bed reactor should be regarded as a promising solution for controlling the solids retention time because it combines the advantages of the filter process with those of the anaerobic contact process. The sludge separation systems in the anaerobic filter and sludge bed reactor are described. A synthetic waste water was

used for the tests, and weekly analyses were made on the chemical oxygen demand (COD) of the influent and effluent. Both methods gave good to very good treatment results within the ranges of organic and hydraulic loads applied. The COD removal rates increased linearly with organic load in both reactors. Large fluctuations in incoming suspended solids to the secondary system of the sludge bed reactor did not affect the effluent quality. The methane content of the gas produced by both methods depended on the organic load. Gas production in the anaerobic filter and the sludge bed reactor decreased with increased hydraulic loading. The net sludge production was very limited in both reactors. (Geiger-FRC)
W81-04130

ORLANDO'S VARIABLE-RATE PUMPING STATIONS SAVE MONEY,

Dawkins and Associates, Inc., Orlando, FL.
D. W. Bouch and J. B. Webb.
Water and Wastes Engineering, Vol 17, No 1, p 20-23, January, 1980. 2 Fig, 2 Tab.

Descriptors: *Pumping plants, *Pumping tests, *Costs, Maintenance costs, Repair costs, Electric power costs, *Waste water facilities, Florida.

The new Orlando, Florida, regional waste water pumping facilities were designed to provide variable rate pumping while minimizing operational complexity, and thus resulted in costs savings. The plant requires fewer sophisticated equipment systems, so maintenance and repair costs will be reduced. The concept of variable rate pumping minimized station operational complexity for the plant, which will ultimately be used by a population of 50,000. During system design, operational power costs were calculated over a typical diurnal range of flows for variable-speed systems versus constant speed pumps. Variable speed systems operating substantially below 80% of full speed were extremely efficient in electric motor, variable-speed drive, and pump hydraulic performance. An analysis for the master pumping station demonstrated annual power savings of about \$8,000 for the multiple constant-speed pump. The proposed plant will be capable of providing advanced waste water treatment. (Small-FRC)
W81-04131

ENERGY SAVINGS CAN FIT YOUR BUDGET,
T. Saxon.

Water and Sewage Works, Vol 127, No 11, p 46-48, November, 1980. 3 Tab.

Descriptors: *Energy conservation, *Budgeting, Cost analysis, Costs, *Waste water treatment, Waste water facilities.

Energy conservation studies made at existing waste water treatment facilities are reviewed. The major area for energy savings lies in the treatment processes themselves. Savings are usually realized in the treatment processes by fine-tuning the system. During activated sludge processes, for example, savings can be realized through manipulation of the solids retention time. Reviewing plant records will give indications of where savings might be realized. Additional savings can result from compliance with the discharge effluent limitations. The use of sludge as a fertilizer or soil conditioner may also increase the efficiency of the total process. Considerations of energy reuse and recovery have led to the increasing interest in low-energy-intensive systems. State and Federal funds are also available which provide 100% nonmatching grant funding for energy audits and energy conservation measures in publicly owned buildings and facilities. (Baker-FRC)
W81-04132

SMALL CITY REQUIRES LARGE WWTP,

W. G. Riddle.
Water and Wastes Engineering, Vol 17, No 7, p 42-44, July, 1980. 2 Fig, 1 Tab.

Descriptors: Treatment plants, *Combined treatment, *Municipal waste water, *Waste water facilities, Industrial wastes, Food-processing wastes.

Waste Treatment Processes—Group 5D

Anaerobic digestion, Sludge disposal, *Montana, Monett.

A waste water treatment plant with a population equivalent of 40,000 was designed for Monett, Montana, to meet Monett's domestic and industrial waste treatment needs. Local wet industries include poultry packing and creameries, a fruit and vegetable wholesaler, aluminum and steel fabrication, shoe manufacturing, plating works, and a large tire wholesaler. The plant utilizes rotating biological discs and has a separate anaerobic sludge digestion plant. A sludge thickener was added to conserve energy. Digester gas, supplemented by natural gas, fires the boilers that provide heat for the digesters as well as heating and cooling the building. Digested liquid sludge is distributed to pastures, the municipal golf course, and city parks. At the plant, BOD₅ has ranged from 4.0 to 19.0 mg/liter, and suspended solids have been less than 4 mg/liter. (Small-FRC)

W81-04133

ELECTROCOAGULATION SOLVES PACKING-HOUSE PROBLEMS,

O. A. Clemens.

Industrial Wastes, Vol 27, No 1, p 22, 24, 25, January/February, 1981. 3 Fig, 2 Tab.

Descriptors: *Industrial wastes, *Meat processing industry, *Electrocoagulation, Biological oxygen demand, Industrial wastewater, Industrial plants, Oxygen demand, *Waste water treatment.

A new method of recovering fats and oils from the waste water of a packinghouse enables the company to reduce operational costs and meet municipal environmental standards. The method uses electrocoagulation and sulfuric acid in place of a trivalent metal coagulant, such as alum, at the isoelectric point of the pollutants. The plant slaughters 500-600 head of cattle per eight hour shift. The plant has rendering facilities, a brine process for hides, a blood recovery system and trucks for disposal of manure. A second 8 hr shift is employed for cleanup and other accessory operations. Effluent guidelines for discharge to the city are 300 mg/L BOD, 300 mg/L total suspended solids and 100 ppm hexane extractables. The new method uses pH adjustment to achieve approximately a zero zeta potential and purify industrial wastewater. This is achieved through adjustment with sulfuric acid. The use of a low pH is not detrimental to the metal structure of the basin, as the basin is cathodically protected by the electrocoagulation operation itself. (Baker-FRC)

W81-04134

POLYMERS PEAK AT PRECISE DOSAGE,

Envirex, Inc., Waukesha, WI.

R. W. Lecey.

Water and Wastes Engineering, Vol 17, No 3, p 39-41, 43, 44, March, 1980. 6 Fig.

Descriptors: *Polymers, *Sludge dewatering, *Centrifugation, Injection, Sludge drying, Sludge conditioning, In situ tests.

A new process was developed for optimizing the polymer dosage and thus making polymer conditioning more effective in centrifugal sludge dewatering. Three different points of injection within the centrifugal dewatering system can optimize polymer dosage: first, just prior to the centrifugal feed inlet; second, prior to the sludge feed pump; and third, immediately after the sludge feed pump. These injection points are effective because they are suited to the effect of polymer charge density, viscosity, and long chain construction that is common to all polymers. Further in-line dilution of the polymer is required after initial polymer solution makeup to insure optimum mixing and dispersion. Dry and liquid polymers are available. Bench screening tests should be conducted to select an optimum polymer. The optimum one will produce a strong, stable floc. Capillary suction time is commonly used to evaluate chemical conditioners used prior to sludge dewatering and is useful in determining approximate chemical dosage rates required to condition sludge for dewatering. (Small-FRC)

W81-04152

NEW PROCEDURES CAN AID WWTP EFFICIENCY, McNamee, Porter, and Seeley, Ann Arbor, MI. V. I. Copperwasser.

Water and Wastes Engineering, Vol 17, No 1, p 34-35, January, 1980. 1 Tab.

Descriptors: *Management planning, *Operating policies, *Documentation, Mechanical failure, Maintenance, Repairing, Scheduling, *Water treatment facilities, Waste water treatment.

A program for waste water treatment plants schedules preventive maintenance and records corrective maintenance to help local governments reduce operation costs. When preventive maintenance work is spread evenly throughout the year, plant personnel can work at optimum efficiency, and plant machinery breakdowns can be significantly reduced. One practical maintenance system uses four forms. The first is a master sheet which summarizes according to building location every preventive maintenance job for every week of the year. Second, at every equipment location, more detailed task descriptions are kept in protective plastic covers. Third, a corrective maintenance work order form is prepared for each corrective task. A chronological record of these tasks is kept so preventive maintenance can be properly scheduled. Fourth, a corrective maintenance log is posted, and corrective maintenance is evenly distributed to personnel. Good operating and maintenance procedures should be initiated at start-up. (Small-FRC)

W81-04154

OUTFALL SYSTEMS CAN ACHIEVE SAFE EFFLUENT LEVELS,

North Carolina State Univ. at Raleigh.

For primary bibliographic entry see Field 8A.

W81-04155

USE OF SHALLOW RESERVOIR AND FLOODED ORGANIC SOIL SYSTEMS FOR WASTE WATER TREATMENT: NITROGEN AND PHOSPHORUS TRANSFORMATIONS, Florida Univ., Sanford. Agricultural Research and Education Center.

K. R. Reddy, and D. A. Graelz.

Journal of Environmental Quality, Vol 10, No 1, p 113-119, January-March, 1981. 6 Fig, 4 Tab, 19 Ref.

Descriptors: *Waste water treatment, *Organic soils, *Reservoirs, Nitrogen, Phosphorus, Phosphates, Waste water management, Drainage canals, Watersheds, Agricultural runoff, Effluents.

This study was conducted to evaluate the relative rates of NH₄-N, NO₃-N, and PO₄-P removal from aerobic and anaerobic water columns with an underlying soil column, to determine the effect of residence time of the waste water above a soil column on inorganic N and PO₄-P removal, to determine the significance of nitrification and NH₃ volatilization in the water column, and to evaluate the P adsorption-desorption characteristics of the anaerobic reservoir sediments and flooded organic soils. The waste water used was obtained from drainage canals surrounding organic soils planted to vegetable crops located in Zellwood, Florida. The study demonstrated that flooded soils and shallow reservoirs can be effectively used for inorganic N levels of waste waters. Both aerobic and anaerobic water columns with an underlying anaerobic soil functioned as an effective treatment system for inorganic N removal. Aerating the water with carbon dioxide-free air resulted in increased losses of NH₄-N through nitrification as compared to NH₃ volatilization. It was concluded that shallow reservoirs with marly clay loam bottoms may be effectively used for reducing ortho-P levels of waste waters. (Baker-FRC)

W81-04159

EFFECT OF MEAN-CELL RESIDENCE TIME ON ORGANIC COMPOSITION OF ACTIVATED SLUDGE EFFLUENTS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

F. M. Saunders, and R. I. Dick.

Journal of the Water Pollution Control Federation, Vol 53, No 2, p 201-215, February, 1981. 16 Fig, 10 Tab, 34 Ref.

Descriptors: *Organic matter, *Microbial degradation, *Waste water treatment, Activated sludge, Domestic wastes, Slime, Washouts, Mathematical equations, Chemical oxygen demand, Water quality, Effluents, Biological treatment.

The effluents of organism washout and resulting changes in microbial populations were studied in an investigation of physical and chemical characteristics of activated sludge suspensions and effluents to determine the quantitative effects of mean cell residence time on the organic quality of activated sludge effluents. Parallel reactors were inoculated with screened activated sludge suspensions and were operated continuously for at least two mean cell residence time values. Two waste waters were used in the experiments - a domestic waste water from the Champaign-Urbana area and a synthetic composition resembling the domestic waste water. The organic characteristics of the effluents were typical of those found in full-scale activated sludge treatment systems. Filterable portions of activated sludge effluents contained dissolved and polymeric slime organic matter. As the mean cell residence time increased, the effluent organic quality improved as a result of decreasing slime and dissolved organic matter. Reductions in effluent chemical oxygen demand also occurred with increasing mean cell residence time. The degradability of total influent organic matter increased with longer mean cell residence times. A general hyperbolic function similar to the classical Monod relationship was generated to relate filterable slime and dissolved organic matter to the mean cell residence time. (Geiger-FRC)

W81-04162

TOTAL ENERGY CONCEPT AT THE JOINT WATER POLLUTION CONTROL PLANT, Los Angeles County Sanitation Districts, Whittier, CA.

G. M. Adams, J. D. Eppich, W. E. Garrison, and J. C. Grateau.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1937-1946, July, 1980. 6 Fig.

Descriptors: *Energy, *Heat transfer, *Secondary waste water treatment, Systems analysis, Waste water facilities, Heat exchangers, Waste heat, Economic aspects, Electric power, Effluents, California, Los Angeles County, Water reuse, Performance evaluation.

The proposed total-energy facilities at the Joint Water Pollution Control Plant in Carson, California, are designed to maximize electrical power production to meet significant increases in demands resulting from the addition of secondary treatment processes and to minimize dependence on public utilities for natural gas and water by reusing waste heat and plant effluent. The generator prime mover selection process includes analyses of reciprocating engines, simple cycle steam and gas turbines, and combined cycles with turbines, with particular emphasis on the design of the system and drive ultimately selected. Heat recovery supplies all process heat demands and also heats and cools the districts' buildings, eliminating any need for natural gas. Self-cleaning heat exchangers minimize in-plant water consumption by using plant effluent and allow curtailment of the operation of expensive cooling towers. Proposed agreements with Southern California Edison and with Southern California Gas companies would give the districts maximum flexibility and reliability with respect to on-site power generation and digester gas usage. The proposed combined cycle power system permits the districts to triple their power demands, decrease their present utility bills, and still be compatible with stringent Los Angeles basin air quality restrictions. (Carroll-FRC)

W81-04166

STOICHIOMETRY AND KINETICS OF BIOLOGICAL WASTE TREATMENT,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Notre Dame Univ., IN.
For primary bibliographic entry see Field 6A.
W81-04167

DISINFECTION OF MUNICIPAL WASTEWATER EFFLUENTS WITH ULTRAVIOLET LIGHT

Illinois Univ. at Urbana-Champaign.

B. F. Severin.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 2007-2018, July, 1980. 4 Fig, 3 Tab, 22 Ref.

Descriptors: *Disinfection, *Municipal wastewater, *Effluents, Ultraviolet radiation, Coliforms, Bacteria, Economic aspects, Costs, Chlorination, Ozonation, Performance evaluation, Waste water treatment.

Ultraviolet light is apparently an effective alternative to chlorine as a means of disinfecting municipal wastewater effluent. The application of a commercially available ultraviolet light water sterilizer to the destruction of fecal coliforms in municipal wastewater effluents was evaluated. Fifteen experiments were performed using primary clarifier effluent, settled activated sludge effluent, activated sludge effluent with waste activated solids added, tertiary sand filter effluent, mixed-media filtration effluent, and trickling filter effluent. The inactivation of fecal coliforms was shown to be related to the transmission of ultraviolet light through the water medium and contact time in the ultraviolet chamber. An empirical model based on theoretical contact time and average light intensity was developed to describe the inactivation of the fecal coliforms. From this model it is possible to estimate the cost of ultraviolet disinfection of wastewater as a function of ultraviolet light transmittance through the water at 254 nm and the level of fecal coliform inactivation desired. The estimated operating costs for inactivating 99.9 percent of the fecal coliforms in secondary and sand-filtered secondary effluent would be about \$0.021 and \$0.015 per 1,000 gallons respectively. UV disinfection was estimated to be less expensive than ozonation for small treatment plants, though more expensive than chlorination. Design of plants specifically for UV disinfection could improve efficiency. (Carroll-FRC)
W81-04168

PREDICTION OF CARBON COLUMN PERFORMANCE FROM PURE-SOLUTE DATA, Manhattan Coll., Riverdale, NY.

J. Famularo, J. A. Mueller, and A. S. Pannu.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 2019-2032, July, 1980. 15 Fig, 4 Tab, 19 Ref.

Descriptors: *Performance evaluation, *Activated carbon, *Mathematical models, Carbon, Prediction, Adsorption, *Waste water treatment, Estimated costs, Model studies.

When water quality regulations stipulate maximum contaminant levels for individual components, the design of carbon columns to achieve these objectives requires an ability to predict the breakthrough of each component. The design of carbon adsorption systems for wastewater treatment is normally based on the time-consuming and costly acquisition of pilot column breakthrough data. This paper presents a method of predicting the performance of granular carbon columns from bench-scale laboratory data in conjunction with an adsorption model, thereby eliminating or greatly reducing the need for pilot studies. Distinguishing aspects of the proposed model include a new conceptual description of the carbon particle that reflects the macropore/micropore structure of activated carbon, a new three-parameter isotherm equation that fits data over a wide range of concentrations, and a multisolute equilibrium calculated from the theory of ideally adsorbed solutions using only pure-solute isotherm parameters (mixture isotherm data is not required). Application of this model to the treatment of a dilute aqueous solution containing two organic solutes demonstrated that the model can quantitatively predict the performance of carbon columns from pure-

solute data for systems that follow the ideal-adsorbed solution theory. The model can be conveniently applied to the design of carbon columns treating multisolute aqueous solutions, and the ability to predict component breakthrough and carbon usage as a function of system size enables accurate cost estimation of the contacting and regeneration systems. (Carroll-FRC)
W81-04169

with a final chlorine dioxide residual of not more than 1.4 milligrams per liter. This goal could be achieved by using chlorine as the disinfectant with chlorine doses greater than 5.0 milligrams per liter and total chlorine residuals significantly higher than 1.4 milligrams per liter at 30 minutes contact time. (Carroll-FRC)
W81-04172

OXYGEN UPTAKE RATE AS AN ACTIVATED SLUDGE CONTROL PARAMETER

Virginia Polytechnic Inst. and State Univ., Blacksburg.

J. H. Sherrard.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 2033-2036, July, 1980. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Activated sludge process, *Oxygen, *Water quality, Effluents, *Waste water treatment, Performance evaluation, Waste water composition.

The use of oxygen uptake rate as an activated sludge process control parameter has been advocated by several authors. It is suggested that under most circumstances oxygen uptake rate can be used only as a gross qualitative parameter of process operating conditions and that only rarely can it be used to control the process. Both theoretical analysis and the results of continuous-flow pilot plant studies indicate that changes in influent waste characteristics and/or flow rate produce large changes in the oxygen uptake rate and minimal changes in effluent quality. For this reason, the oxygen uptake rate does not appear to present any quantitative information to a treatment plant operator and has limited use for control purposes. Oxygen uptake rate can be used for control purposes only when influent flow rate and waste water composition are relatively constant and steady-state conditions are approximated. More reliable process control information can be obtained by directly measuring aeration basin dissolved oxygen concentration and effluent quality. (Carroll-FRC)
W81-04170

IMPLEMENTATION OF EPA'S MUNICIPAL COMPLIANCE PROGRAM, Environmental Protection Agency, Washington, DC. Office of Water Enforcement.

For primary bibliographic entry see Field 6E.
W81-04171

COMPARISON OF CHLORINE AND CHLORINE DIOXIDE AS DISINFECTANTS, Texas Univ., San Antonio.

K. E. Longley, B. E. Moore, and C. A. Sorber.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2098-2105, August, 1980. 8 Fig, 3 Tab, 14 Ref.

Descriptors: *Chlorination, *Disinfection, *Waste water treatment, Chlorine, Coliforms, Bacteria, Performance evaluation, Residual chlorine, Mixing, Chlorine dioxide.

The relative biocidal efficiencies of chlorine and chlorine dioxide in a waste water stream containing fecal coliforms and coliphages were evaluated. The tests were conducted on a side stream of a contact stabilization waste water treatment plant effluent which was passed through a proprietary, plug-flow mixer. The test results showed that chlorine dioxide was a superior disinfectant relative to chlorine for the inactivation of fecal coliforms and coliphages in this system, in which doses and concentrations of chlorine and chlorine dioxide were expressed in terms of equivalent Cl₂. Chlorine dioxide inactivation of fecal coliforms and coliphages was not sensitive to mixing intensity within the highly turbulent flow ranges evaluated. The secondary waste water used in the test system exerted a very rapid demand on the chlorine dioxide. The chlorine dioxide demand was greater than the chlorine demand when both were expressed in terms of Cl₂. A fecal coliform disinfection goal of 200 colony-forming units per 100 milliliters using chlorine dioxide as the disinfectant was exceeded

DYNAMIC MODELING OF INDUSTRIAL WASTE WATER TREATMENT PLANT DATA, Union Carbide Corp., South Charleston, WV.

J. L. Hansen, A. E. Fiok, and J. C. Hovious.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1966-1973, July, 1980. 17 Fig, 4 Ref.

Descriptors: *Industrial waste water, *Waste water facilities, *Systems analysis, Model studies, Data analysis, Dynamic programming, Effluents, Water quality, Performance evaluation, Mathematical models, Simulation, Waste water treatment.

The responses of waste water treatment plants to various inputs must be better understood and plant operation optimized if existing facilities are to achieve the goals specified by tighter permits. The data collected daily by a treatment plant contain important information about system dynamics and performance that is not currently used to best advantage. Multiple linear regression was used to develop discrete dynamic models for activated sludge systems treating complex organic chemical manufacturing wastes. The dynamic modeling technique was applied successfully to a historical data record from an industrial waste water treatment plant. Effluent character was related to system variables, and the models were used to define operating strategies and system modifications for improving performance. The models simulate plant responses to changing inputs, and the steady-state form predicts the average effects in the ranges in which data were collected. Although these techniques are useful for analyzing historical data, designed experiments should be used to generate data for optimization and control whenever possible. (Carroll-FRC)
W81-04173

OPTIMIZATION OF GRIT REMOVAL AT A WASTE WATER TREATMENT PLANT, Municipality of Metropolitan Seattle Renton, WA. Renton Treatment Plant.

R. E. Finger, and J. Parrick.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2106-216, August, 1980. 12 Fig, 4 Tab, 11 Ref.

Descriptors: *Waste water facilities, *Grit removal, Solids, Separation techniques, Dewatering, Maintenance, Economic aspects, Process efficiency, Clogging.

Inefficient removal of grit from the bulk waste water flow exposes primary sludge collection and pumping equipment to excessive wear from abrasive grit and results in grit accumulation in plant digesters and distribution channels. The process of removing accumulated grit from these units is expensive and time-consuming. When operational problems at the Renton Treatment Plant in Seattle, Washington, were traced to the grit removal system, a program was undertaken to evaluate and correct these problems. The performance of the aerated grit removal system was substantially improved by adjusting aeration rate and distribution. Tapered aeration helped equalize loading on the grit pumping and dewatering equipment. A screening unit installed on the grit cyclone discharge reduced the frequency of clogging of cyclone over-flow lines from sticks, rags and plastic and allowed these materials to be removed permanently from the flow system before they reached the raw sludge. New problems caused by the improvements to the performance of the existing system including the need to install a mechanically-cleaned screening system for the cyclone overflows due to the high volume of materials collected and the failure of the grit dewatering units to capture the fine grit due to hydraulic overloading. In spite of these problems, the system improve-

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ments resulted in increased grit removal and in a substantial reduction in the amount of grit escaping from the grit system. Periodic evaluation an adjustments should be scheduled to insure that changes in flow rates, grit loading, plant modifications, or revised operating procedures have not affected grit system performance adversely. (Carroll-FRC) W81-04174

MT. ST. HELENS: HOW A WASTE WATER PLANT COPED WITH ITS AFTERMATH,
Yakima Waste Water Collection and Treatment Facilities, WA.
T. G. Day, and J. E. Fisher.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2082-2089, August, 1980. 6 Tab.

Descriptors: *Waste water facilities, *Volcanos, *Waste water treatment, *Mount Saint Helens(Washington), Volcanic ash, Waste water collection, Disasters, Biological treatment, Cleanup operations.

The eruption of Mt. St. Helens resulted in the deposition of about 0.5 million tons of ash on the city of Yakima, Washington. Yakima received two distinct types of ash, one of which was composed of sand-like material and the other of which was very fine and powder-like. The sand-like material was very abrasive and heavy, while the other ash formed a substance much like mortar when mixed with water. Both types of ash posed serious problems for the Yakima Regional Waste Water Facility. By the day after the eruption, the plant was experiencing equipment failures, and pumping problems developed on the following day. three days after the eruption, city officials and regulatory agency representatives decided to bypass the treatment plant in order to avoid damaging equipment beyond repair. By the next day, the bypass was constructed and temporary chlorination facilities were operational. A sludge storage lagoon was begun, and chlorinated waste water was discharged to the Yakima River. The bypass was in effect for four days. Waste water was diverted back to the plant after cleanup of the clarifiers, degritters, and other equipment had been completed. An intensive cleanup of collection systems was then conducted over the next two weeks. Almost a month passed before the influent returned to normal parameters and the adverse effects of the ash ceased to pose continuing operating problems. As a result of this experience, a list of short-term objectives has been developed for implementation in the event of another eruption jeopardizing the waste water operations. In addition, design alternatives have been identified to minimize the effects of any potential future eruptions. (Carroll-FRC) W81-04175

ANAEROBIC ATTACHED-FILM EXPANDED-BED REACTOR TREATMENT,
Clarkson Coll. of Technology, Potsdam, NY.
M. S. Switzerbaum, and W. J. Jewell.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1953-1963, July, 1980. 14 Fig, 3 Tab, 28 Ref.

Descriptors: *Anaerobic digestion, *Biological waste water treatment, Waste water treatment, Performance evaluation, Microorganisms, Organic matter, Filter media, Retention time.

The process variables that affect the performance of an anaerobic attached film expanded bed reactor treating dilute organic wastes were analyzed. This process consists of inert sand-size particles, packed in cylindrical column, which expands slightly with the upward flow of waste through the column. The inert particles act as a support surface for the growth of large amounts of attached microorganisms. The process permits maintenance of high solids retention time with low hydraulic retention time. This anaerobic process was found effective for treatment of dilute organic wastes at reduced temperatures, at short duration times, and at high organic loading rates. The unusually high effectiveness of the process is believed to result from the large surface-area-to-volume ratio created by the inert support medium, which enables a large active mass of attached microorganisms to remain

in the reactor at high liquid flow rates. The application of two simplified first-order equations relating process efficiency to net specific growth rate of film and to specific substrate utilization rate showed that these two fundamental process operational variables were important process control variables. (Carroll-FRC) W81-04176

YEAST CREATES FOAM PROBLEM,

Williamsport Sanitary Authority, PA.
M. Gerardi, and M. B. Gerardi.
Water and Sewage Works, Vol. 127, No. 1, p 56-57, January, 1980. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Yeasts, *Foaming, *Aerated lagoons, Clarifiers, Scum, *Waste water treatment, Treatment plants, Chlorination, Dissolved oxygen.

The growth and propagation of baker's yeast caused foam and scum problems at the Central Waste Water Treatment Plant of the Williamsport Sanitary Authority. A persistent brown foam containing numerous large pockets of confined gas and exhibiting filamentous growth appeared on the surface of secondary aeration tanks. There was also scum on the secondary clarifiers. Isolation and identification of the predominant bacteria associated with foam and scum samples produced several Enterobacteriaceae. Laboratory tests were performed to isolate the yeasts. Control methods include chlorination of return solids to the aeration tank, which breaks the filamentous network of the yeast-mixed-liquor aggregate and permits removal. Close monitoring of in-plant operations to regulate dissolved oxygen concentrations to a low level and thus reduce the growth rate of the yeast is a more effective control method. The best control measure is elimination of the source. (Small-FRC) W81-04180

KINETICS OF BIODEGRADATION OF CHLORINATED ORGANICS,

Minnesota Univ., Minneapolis.
N. A. Shamat, and W. J. Maier.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2158-2166, August, 1980. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Biodegradation, *Kinetic, *Organic compounds, *Chlorine, Chlorinated organic, Halogens, Waste water treatment, Activated sludge process, Microbial degradation, Microbiological studies, Feasibility studies.

There is a lack of precise information about the feasibility, effectiveness, and limitations of biological waste treatment for removing chlorinated organic compounds likely to be found in waste water. A study was conducted to determine whether activated sludge biomass could be used to develop microbial populations capable of completely metabolizing chlorinated organic compounds and to study the kinetic parameters of these populations in order to assess the feasibility of removing chlorinated organic wastes by the activated sludge process. Enriched cultures capable of completely biodegrading chlorinated compounds were obtained from municipal waste water treatment plants. An initial lag phase was observed until an enriched microbial culture was established. The metabolized chlorinated compounds were transformed to cell mass, carbon dioxide, chloride ions, and water, with no substantial accumulation of intermediates. The kinetics of removal of the chlorinated compounds were correlated in terms of conventional activated sludge kinetics based on bacterial growth. Stable active functional populations have been maintained over an extended period of time in continuous-flow reactors using the target substrate as the only source of carbon and energy. It is concluded that utilization of an activated sludge type of process in the treatment of some chlorinated organic wastes is feasible. (Carroll-FRC) W81-04181

SEPTAGE TREATMENT AT A MUNICIPAL PLANT,
Lowell Univ., MA

B. A. Segall, and C. R. Ott.

Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2145-2157, August, 1980. 9 Fig, 6 Ref.

Descriptors: *Waste water facilities, *Septic tanks, *Waste water treatment, Septic waste water, Municipal waste water, Waste water, Waste water disposal, Medfield, Massachusetts, Activated sludge process.

Many communities in New England are faced with septic tank waste disposal problems. Currently used land or water discharge practices are often expeditious that cause gross environmental contamination and pose a threat to public health. The effects and costs of high septage loading were examined at a municipal waste water treatment plant in Medfield, Massachusetts, operated as an extended aeration process. A three-phase experimental program included monitoring of processes and waste water characteristics during a septage-free period, addition of septage at a constant rate of 3.8% for 7 days, and feeding of septage in slug loads at at rate of one shock load each morning for 3 or 4 days. Microbiological examination of mixed liquor, dissolved oxygen measurements, and effluent monitoring showed that septage is oxidized effectively when processes are loaded within design capacities. Since septage is about 50 times as concentrated as domestic waste water, a constant 2% addition of septage nearly doubles the organic input to aeration basin at extended aeration facilities. The quality of septage that a waste water treatment facility can handle is limited by available aeration and/or solids handling capacity. An existing extended aeration facility that is loaded with waste water to 25% of its design capacity can reasonably be expected to take a 3% by volume addition of septage, while the recommended septage loading at 75% capacity is 1%. When septage is fed in slug loads to aeration basins, the loading limit should be about half the values suggested for constant loading. Design parameters for new facilities intended to accept septage are discussed. (Carroll-FRC) W81-04183

FLOW AND LOAD VARIATIONS AT WASTE WATER TREATMENT PLANTS,
Ross, Saarinen, Bolton and Wilder, Fort Lauderdale, FL.

D. C. Munksgaard, and J. C. Young.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 3131-3144, August, 1980. 6 Fig, 8 Tab, 23 Ref.

Descriptors: *Waste water facilities, *Flow characteristics, Flow rates, Flow profiles, Municipal waste water, Raw waste water, Waste water management, Waste water analysis, Systems engineering, Engineering, *Design criteria.

In order to design waste water treatment facilities so that they give good performance during peak load periods, it is necessary to be able to predict peak flows and loads. A study of peak loads at 11 full-scale operating waste water treatment plants was undertaken in an effort to develop equations for predicting peaking factors for design purposes. All of the cities represented had separate sanitary and storm sewers and it was estimated that less than 20% of the total waste flow or load came from industrial sources. Operational data from the facilities were analyzed to determine peak month, peak day peak 8-hour, and peak 4-hour flows and biological oxygen demand, suspended solids, ammonia nitrogen, and total phosphorus loads. Relationships between these peak loads and average annual loads or populations were then calculated. Analysis of the flows and loads received at the 11 facilities showed a remarkably consistent relationship between peak flow or load and the average annual value. The high correlation coefficients for all relationships suggest that factors governing peak-to-average flow ratios are similar for all cities. In the absence of good operating records or when conducting feasibility studies, preparing facilities plans, or making cost estimates, the equations developed in this study could be used, with caution, for estimating peak flows and loads for cities having average annual flow rates between 0.1

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and 100 million gallons per day. In addition, designers should use sound engineering judgement in the application of these study results to cities located in either dry or very wet climates or those having heavy industrial waste contributions or combined sewer systems. (Carroll-FRC)
W81-04184

DETOXIFICATION OF SPECIFIC ORGANIC SUBSTANCES BY WET OXIDATION,
Zimpro, Inc., Rothschild, WI.
T. L. Randall, and P. V. Knopp.
Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2117-2130, August, 1980. 8 Fig, 8 Tab, 22 Ref.

Descriptors: *Wet oxidation process, *Detoxification, *Organic compounds, Oxidation, Waste water treatment, Industrial waste water, Toxic substances, Process efficiency, Catalysts, Temperature, *Effluents, Toxicity, Standards.

Final effluent standards have been adopted by the Environmental Protection Agency for manufacturers of a variety of toxic compounds. Laboratory batch studies using a single, pure compound in distilled water as the starting material were used to evaluate the effectiveness of wet oxidation, or the Zimmermann Process, in achieving maximum destruction of the starting materials and thus detoxifying the selected represented organic compounds. Wet oxidation of toxic compounds was demonstrated to be an excellent method for detoxifying these materials. Destruction of 99.8 plus percent of the starting materials was achieved by wet oxidation at 320°C for one hour. Oxidation at 275°C for one hour produced over 99% destruction of most compounds. A copper catalyst was effective in bringing about the destruction of several of the more slowly reacting compounds at the 275°C temperature. In general, the toxicity of the oxidized materials was greatly reduced compared with that of the starting materials. Oxidation at 275°C was nearly as effective in reducing toxicity at 320°C oxidation. The toxicity tests were short term and designed to provide only acute static toxicity measurements. (Carroll-FRC)
W81-04185

NEW DEVELOPMENTS IN THE DESIGN OF DEBALLASTING FACILITIES,
P. Theobald.
Progress in Water Technology, Vol 12, No 4, p 463-472, 1980. 3 Fig.

Descriptors: *Ballast, *Bilge, *Treatment facilities, Oily water, Ships, Separation techniques, Recycling, Water treatment, Brest, France.

A new deballasting treatment plant located at Brest on the Mediterranean is described. Brest is an important French repair port. The installation consists of three reception tanks with a combined area of 25,000 cu m. A degritter separates solids out of the ballast, and a new parallel separator is used to remove oil. Separator effluent is discharged into a pond. The solids recovered from the ballast water are treated with lime and stored in ponds, where they are treated with water jets. The oil, water, and sediments are again separated, and the end product is used as a fill material. The oil is recycled back to the primary treatment facilities and the water is reused in the water jets. This process used for the treatment of sludge can also be used to treat sand and rocks that are covered with oil. (Small-FRC)
W81-04205

WASTE WATER TREATMENT PLANT AT WUPPERTAL-BUCHENHOFEN FOR 1,200,000 POPULATION EQUIVALENTS,
Wupperverband, Barmer(Germany, F. R.).
H. Brechel.
Progress in Water Technology, Vol 12, No 5, p 369-381, 1980. 7 Fig, 8 Ref.

Descriptors: *Treatment plants, *Chemical wastes, *Domestic wastes, Activated sludge process, Oxygen, *Waste water treatment, Aeration, Biochemical oxygen demand, *Germany, Wuppertal-Buchenhofen treatment plant.

The separate treatment of chemical and domestic wastes at the Wuppertal-Buchenhofen plant is described. The solvent-contaminated chemical wastes are treated in a two-stage oxygen process. 20,000 cu m/day of the wastes has a pollution load of 34 mg BOD₅. The use of pure oxygen for aeration allows a higher oxygen transfer than when air is used, so that with a high sludge concentration and a high sludge loading, a sufficiently high concentration of dissolved oxygen in the activated sludge suspension is possible. The biological breakdown of the industrial waste is carried out in covered tanks, so odor is kept to a minimum. The domestic waste is treated in a conventional activated sludge plant, and a standard BOD₅ level of 25 mg/liter is reached. The daily quantity of municipal wastes of 160,000 cu m, with a pollution load of 60 mg BOD₅. The activated sludge process has fine bubble aeration. The plants have been in successful operation since 1976-77. (Small-FRC)
W81-04208

COMBINED ANAEROBIC-AEROBIC TREATMENT OF WASTE WATERS FROM FOOD AND FERMENTATION INDUSTRIES,
Swedish Water and Air Pollution Research Lab., Stockholm.
J. Normann.
Progress in Water Technology, Vol 12, No 5, p 725-729, 1980. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Aerobic treatment, *Anaerobic treatment, *Food-processing wastes, Foreign projects, Biochemical oxygen demand, Nitrogen removal, Ammonia, Capital costs, Methane, *Waste water treatment.

A flexible, energy-saving combined anaerobic-aerobic system for the treatment of waste water is described. The first stage of the ANAMET process is anaerobic, and the second stage is aerobic. The system is particularly efficient for the treatment of industrial waste water which contains biodegradable compounds. An ANAMET plant which processes wastes from a sugar beet processing plant achieves a high BOD₇ reduction with methane production and a low sludge production. The process can be used for nitrogen removal from waste water high in nitrogen with the use of an ammonia-stripping stage between the anaerobic and aerobic stages. The ammonia can be recovered as ammonia salt that can be used as a fertilizer. ANAMET plants are compact and have low investment costs of about \$50 to 100/kg BOD₇/day. For many applications, the value of the methane gas which is produced more than covers the total operating cost for waste water treatment. (Small-FRC)
W81-04210

A COMPARISON OF LIME ASSISTED SEDIMENTATION AND CONVENTIONAL TREATMENT AT A LARGE MUNICIPAL WORKS TO REDUCE THE NEED FOR INDUSTRIAL EFFLUENT CONTROLS,
Hawksley (Watson), High Wycombe (England).
S. D. Myers, and C. M. Ainger.
Progress in Water Technology, Vol 12 No 5, p 447-453, 1980. 3 Tab.

Descriptors: *Chemical precipitation, *Lime, *Industrial wastes, Food-processing wastes, Tannery wastes, Textile mill wastes, Foreign projects, *Waste water treatment, Metals, Costs.

Lime assisted sedimentation followed by inshore discharge of the effluent was considered as a treatment and marine disposal option in the Greater Athens liquid wastes disposal study. Industrial effluents, principally textiles, tanneries, and food processing, currently make up about 35% of the sewage flow discharged to municipal sewers. Lime addition prior to sedimentation would increase removal of suspended solids, BOD, and phosphorus. Also, there would be a disinfectant effect, increased clarity, and precipitation of metals. Disadvantages of lime assistance include the fact that it is 20% more expensive than unassisted sedimentation with discharge through a long outfall. If the metal content of the sewage were greater than it is in Athens, the extra cost of the lime addition would

be offset by a reduced need for industrial effluent monitoring. (Small-FRC)
W81-04211

FEASIBILITY STUDY OF TREATMENT PROCESSES - CASE STUDY OF A LARGE TOWN: MARSEILLES,
Service de l'Assainissement, Marseilles (France).
P. Lacroix, D. du Clary, and B. Hoyaux.
Progress in Water Technology, Vol 12, No 5, p 433-443, 1980. 3 Fig, 4 Tab.

Descriptors: *Treatment plant, *Feasibility studies, *Waste water treatment, Sedimentation, Municipal wastes, Industrial wastes, Case studies, *Marseilles, France.

A preliminary study of the sewage treatment plant for the city of Marseilles (France) included the following: the choice of sites for the waste water and sludge treatment plants, a different treatment processes of the water and sludge, and the impact of industrial sewage. The plant will treat domestic sewage of one million inhabitants and an industrial sewage equivalent to that produced by half a million inhabitants. It was decided to construct the waste water treatment plant in the center of the city but to put it underground. The sludge treatment plant will be located in the mountains 6 km away. Waste water treatment will consist of primary sedimentation. Further treatment may include ocean discharge. Sludge treatment has not been determined, but various methods, including anaerobic digestion, thickening, pasteurization, and incineration are being considered. (Small-FRC)
W81-04212

WASTE TREATMENT BY PRECIPITATION WITH LIME - A COST AND EFFICIENCY ANALYSIS,
Technische Univ., Munich (Germany, F.R.). Lehrstuhl und Prufamt fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
H. Hruschka.

Progress in Water Technology, Vol 12, No 5, p 383-393, 1980. 6 Fig, 4 Tab, 9 Ref.

Descriptors: *Chemical precipitation, *Lime, *Cost analysis, *Waste water treatment, Calcium hydroxide, Flocculation, Capital costs, Operation costs, *Germany, Starnberg.

The possibility of improvement of plant efficiency by implementing lime precipitation was evaluated for the Starnberg (Germany) plant, which is designed for 100,000 population equivalents with a sewage inflow of 25,000 cu m and a BOD load of 6500 kg/day. Two process changes were evaluated: calcium hydroxide dosage in the inlet of the primary tanks, and dosage without any flocculant dosage. The goal of the experiments was to relieve the burden on the biological treatment process by eliminating the pollution load in the primary tanks. The BOD elimination rate increased to 59%-62% with flocculants and about 36% without. Capital costs are estimated at 2 DM per inhabitant for plants with 100,000 population equivalents. Operating costs were 135.72 DM per ton, and the lime costs 0.81 DM per inhabitant. Precipitation with lime is an alternative which can reduce chlorine or sulfate loads to receiving waters. The amount of sludge does increase, which can add operating costs of up to 1.13 DM per inhabitant. (Small-FRC)
W81-04213

TREATMENT PLANT ODORS AND NEIGHBOURS: A CASE HISTORY,
Los Angeles County Sanitation Districts, CA.
R. F. Luthy, Jr., J. G. Haworth, Jr., D. E. Avila, M. Moshiri, and K. L. Lewinger.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1923-1930, July, 1980. 7 Fig, 7 Ref.

Descriptors: *Waste water facilities, *Public relations, *Odors, Odor control, Public participation, Public opinion, Waste water treatment, Los Angeles County, California.

The Sanitation Districts of Los Angeles County developed a plan to deal with odor complaints

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from neighbors of a large pollution control plant in Carson, California. The odor problem was traced to increased solids production and water turbulence at the plant, which was the result of new systems constructed in response to state and federal requirements. Analysis culminated in immediate operation changes and design of new odor control systems. At the same time, the Districts organized a public participation program to inform and involve local citizens in the operation of the treatment plant. Homeowners were invited to attend meetings to hear about the actions being taken to solve the odor problem. The meetings culminated in the formation of a citizens' advisory committee representing the interests of the area homeowners and relaying pertinent information to the community. The districts' staff was able to substantially reduce the odors produced at the plant, and a new degree of cooperation and credibility was established with area homeowners. (Carroll-FRC) W81-04215

OPERATIONAL FACTORS AFFECTING BIOLOGICAL TREATMENT PLANT PERFORMANCE,
Gannett, Fleming, Corddry and Carpenter, Inc., Harrisburg, PA.
A. C. Gray, P. E. Paul, and H. D. Roberts.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1880-1892, July, 1980. 12 Fig, 2 Tab, 11 Ref.

Descriptors: *Performance evaluation, *Biological waste water treatment, *Water quality control, Effluents, Water quality standards, Waste water treatment, Waste water facilities, Economic aspects, On-site investigations.

Approximately 120 biological treatment plants of various sizes and types were studied to identify operational and maintenance deficiencies and to make recommendations for improved plant performance without significant capital expenditures. Thirty plants were selected for extended field study of up to one week, during which a detailed evaluation of plant performance was made. Samples were taken and analyzed to evaluate the performance of each unit process in the plant. Detailed staffing and budgetary information was also obtained from each plant. The study results indicate that the deficiencies in biological treatment plant performance result largely from a lack of routine evaluation of key operating parameters and implementation of process control techniques. Specific recommendations for addressing these problems relate to the need for improvement of operator training programs, specifically with respect to emphasis on the relationship between process control and effluent quality; emphasis on more positive action to assure that process control techniques are practiced at the treatment facilities; more careful consideration of plant operability and flexibility during the design stage; consultation with the principal operating personnel during plant design and preparation of operations and maintenance manuals; increased attention to the process control sections of these manuals; and more organized and needs-sensitive budgeting for the operation and maintenance of waste water treatment facilities. (Carroll-FRC) W81-04216

WASTE WATER DISINFECTION—CURRENT PRACTICES,
B. P. Johnson.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1865-1868, July, 1980. 1 Fig, 4 Tab.

Descriptors: *Waste water treatment, *Disinfection, *Surveys, Chlorination, Waste water facilities, Process efficiency, Water pollution, Costs, Performance evaluation, Water analysis.

The Waste water Disinfection Committee of the Water Pollution Control Federation conducted an extensive survey of disinfection practices in the United States and Canada during April, 1979, in order to accumulate information on the design, operation, and performance of waste water disinfection systems. Of the 2,765 questionnaires sent to

managers and operators of waste water treatment facilities, 740 were returned. The responses represented small and medium-sized municipal systems for the most part. Only six percent of the responses were from Canada. Information provided covered influent and effluent characteristics, disinfection practices, chemical agent used, contacting and mixing systems, chemical dosage control systems, analysis of the chemical residuals, techniques used to evaluate the coliform kill effectiveness, use of bioassay studies of receiving waters, cost of disinfection, safety experiences, and ecological damage resulting from disinfectant use. (Carroll-FRC) W81-04217

TUBE SETTLERS IN SECONDARY CLARIFICATION OF DOMESTIC WASTEWATERS,
United Nations Children's Fund, Dacca (Pakistan).
J. B. Mendis, and A. Benedek.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1893-1897, July, 1980. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Clarification, *Secondary waste water treatment, *Settleable solids, Tubes, Waste water treatment, Sedimentation, Settling velocity, Performance evaluation, Settling basins, Domestic wastes.

This report analyzes the use of tube settlers installed to upgrade the capacity of the full-scale clarifier at a waste water treatment plant located in Winnipeg, Manitoba, Canada. Variables governing both the biological conditioning within the aeration tank and the hydraulic effects on the clarifier were monitored. A 1.52-meter polymethyl methacrylate column was used to monitor the zone settling velocities of mixed liquor concentrations, from which the limiting hydraulic and solids loadings were determined. A pulse input dye was used to trace the overflow and return hydraulic behavior within the clarifier. Tubed and nontubed full-scale secondary clarifiers were compared. Results indicated that when the solids separation process is clarification-limiting, the tube settlers permit overflow rates of up to 4 meters per hour of clarifier surface area, which is between 50 and 100 percent greater than the capability of similar nontubed basins. When the solids separation process is thickening dependent, the tubes do not provide additional capacity, but do improve the quality of the effluent. Effluent solids sedimentation begins to deteriorate as the return rate exceeds 0.88 meters per hour, probably due to serious short-circuiting in the underflow. (Carroll-FRC) W81-04220

NEW FACILITIES SERVE DUAL COMMUNITY ROLE,
Camp, Dresser and McKee, Boston, MA.

G. A. Dunbar, and D. S. Sloan.
Water and Wastes Engineering, Vol 17, No 3, p 16-19, March, 1980. 2 Tab.

Descriptors: *Universities, *Engineering education, Education, Waste water treatment, Amherst, Massachusetts.

The new Amherst, Massachusetts, waste water treatment facility was designed and built to serve as a teaching and learning adjunct to the University of Massachusetts and other local educational institutions. Visual obstructions are minimal. Signs throughout the plant explain the processes. Pipes and ducts are color-coded and labeled with contents and flow direction. Stairs, halls, etc., are of ample dimensions and are well lit. Special attention to the educational purposes is reflected in the large laboratory also used by university interns, exhibition and conference areas, a pilot plant, and knowledgeable, articulate plant staff. (Cassar-FRC) W81-04227

LIME STABILIZATION,
Cargill Corp., Pittsburgh, PA.

E. Rausch.
Southwest and Texas Water Works Journal, Vol. 62, No. 5, p 14-15, August, 1980.

Descriptors: *Lime, *Soil amendments, *Sludge treatment, Sludge disposal, Waste water treatment,

Disposal, Ultimate disposal, Coagulation, Polymers, Filters.

Dewatering problems encountered in the lime stabilization process of treating primary and secondary filterable sludge may be overcome by choosing a polymer which functions effectively at high pH (pH 12 or higher). Polymer samples from 40 suppliers were tested by one New England municipality to find a coagulation polymer compatible with lime stabilized sludge. Best results were obtained with a liquid synthetic polyelectrolyte cationic polymer. Plant trials under operating conditions with this product are underway. The sludge produced is pathogen-free and low-odor, and is suitable for land application. Advantages over incineration are low chemical and fuel costs, drier sludge cake, and heavy metal insolubilization. (Cassar-FRC) W81-04238

CHEMICAL INHIBITION OF BIOLOGICAL NUTRIENT REMOVAL PROCESSES,
National Inst. for Water Research, Pretoria (South Africa).

C. Knoetze, T. R. Davies, and S. G. Wiechers.
Water SA, Vol 6, No 4, p 171-180, October, 1980. 8 Fig, 3 Tab, 7 Ref.

Descriptors: *Organic wastes, *Heavy metals, *Nutrient removal, Nitrification, Denitrification, Pesticides, Biological treatment, *Waste water treatment, Activated sludge, Sewage bacteria, Toxins, Inhibitors, Laboratory tests.

The inhibitory effects of organic inhibitors and various heavy metals on biological waste water treatment processes were examined in laboratory-scale activated sludge and biological rotating disc units. Bacteria obtained from denitrifying rotating disc units were transferred to a synthetic sterile medium and treated with the different inhibitors. After incubation at 20 degrees, the growth rate was determined by spectrophotometric turbidity measurements every 4 hours. All of the heavy metal ions tested showed no detrimental effects in raw sewage at levels below 1 milligram/liter. No impairment of oxidation of carbonaceous matter was found in the activated sludge units even when nitrification and denitrification were greatly inhibited and some of the mixed liquor suspended solids were killed and carried off in the effluent. When the denitrifying, nitrifying rotating disc and activated sludge units were given enough time to adapt, they all developed resistance to the inhibitors studied. The need for regulation of levels of heavy metals and organic inhibitors in the feed to biological waste water purification systems is stressed. (Geiger-FRC) W81-04251

WASTE WATER TREATMENT FOR PHOSPHORUS REMOVAL,
R. W. Ockershausen.

Water and Sewage Works, Vol 127, No 8, p 40-41, August, 1980. 4 Fig.

Descriptors: *Phosphates, *Coagulation, Alum, Phosphorus compounds, Precipitation(Chemical), Waste water treatment, Separation techniques, *Phosphorus removal.

Ten year of experience in removing phosphorus from waste water by alum precipitation shows that this has been successful in several cities. Avon Lake, Ohio, in the Great Lakes Drainage Basin, was one of the first cities to remove P on the continual basis. Phosphorus removal was 90% with alum and zero without. The Richardson, Texas, plant removes 96.8% of P (initial concentration 12 to 15 mg per liter), using a dosage of 150-160 mg alum per liter. Warren, Michigan removes 83.9% P with alum treatment, and Windsor, Ontario, 86.5% total P, 91.1% orthophosphate, and 95.4% dissolved orthophosphate. (Cassar-FRC) W81-04252

DESIGNING FOR ARID CLIMATES,
Taylor (John) and Sons, London (England).
For primary bibliographic entry see Field 8A.
W81-04253

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

WATER AND SANITATION PROBLEMS IN INDIA

California State Univ., Long Beach.
S. Barfield.

Journal of Environmental Health, Vol 43, No 4, p 204-205, January/February, 1981.

Descriptors: *Well drilling, *Long-term planning, *Environmental sanitation, Public health, Drinking water, Waste water treatment, Developing countries, *India.

Progress in rural and urban sanitation in India is reviewed. Many rural water supplies are contaminated with cholera or guinea worms, and urban sanitation is inadequate. In New Delhi in 1979, the water was so polluted with sewage and industrial wastes that the government declared it unfit for watering gardens. Many well rigs were purchased to drill wells in desert areas to provide the population with drinking water. A record number of 32,000 villages were thus provided with drinking water in 1979-80. In India's new Five Year Plan, high priority is given to providing drinking water to rural areas and to providing the maximum possible number of people with safe water and hygienic waste supply systems. The American Public Health Association and the World Federation of Public Health Associations are sponsoring a continuing education tour of India in conjunction with the International Congress on Primary Health Care in 1981. Themes of the conference will include national planning, and training and education of water personnel. (Small-FRC)
W81-04256

CUT O & M COSTS THROUGH VALUE ENGINEERING

A. R. Vondrick.
Water and Wastes Engineering, Vol 17, No 9, p 58-59, September, 1980.

Descriptors: *Operation and maintenance, *Value engineering, *Cost analysis, Maintenance costs, Operating costs, *Waste water treatment, Evaluation, Construction costs.

Value engineering is useful in eliminating potential operation and maintenance problems in waste water treatment plants. This concept is an objective look at alternatives, considering life cycle costs. Examples are given where the 'second look' of value engineering is applied to plant designs, reducing operating and maintenance costs such as manpower, painting, energy costs, and time, while economically increasing capacity and quality. (Cassar-FRC)
W81-04261

AERATORS ALLOW FOR DOWNWARD EXPANSION

Water and Wastes Engineering, Vol 17, No 2, p 53, February, 1980.

Descriptors: *Aeration, *Oxygen, *Waste water treatment, Appleton, *Wisconsin, Underground construction, Water treatment facilities.

Increased waste water loads were handled at the Appleton, Wisconsin, treatment plant by tripling the aeration tank volume and oxygen transfer capacity. Since the plant was unable to expand laterally, the new equipment was constructed so that the tanks were double the previous depth, 30 feet, considerably below ground level. Oxygen transfer efficiency was improved, and winter misting and icing has been greatly reduced. (Cassar-FRC)
W81-04265

EXTRACT HEAVY METALS VIA LIQUID-ION EXCHANGE

Pirnie (Malcolm), Inc., White Plains, NY.
D. A. Cornwell, and G. P. Westerhoff.
Water and Wastes Engineering, Vol 17, No 2, p 37, 38, 42, 1980, 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Sludge, *Heavy metals, *Ion exchange, Metals, Separation techniques, Solvents, *Waste water treatment, Cadmium, Copper, Iron, Zinc, Nickel, Manganese, Chromium.

Waste water sludges containing heavy metals may be treated by liquid-ion exchange. This process uses an organic solvent, immiscible in water. The solvent is composed of an organically soluble chemical, a diluent and a second organic liquid (10% by volume mono-di(2-ethylhexyl) phosphoric acid diluted in Kermac 627). During the metal transfer from water to solvent, an organically soluble metal complex is formed. At pH 2 and 4% feed sludge, the following metals were extracted at rates of greater than 95%: Fe, Zn, Cd, Mn, and Cu; Ni extraction was 41%. A different solvent would be required for removal of Cr, which exists as an anion at the low pH used. (Cassar-FRC)
W81-04266

KEEP DIGEST + RS CLEAN

Meriden Sewer Authority, CT.
B. Nicolai.
Water and Wastes Engineering, Vol 17, No 7, p 37-39, July, 1980.

Descriptors: *Mechanical equipment, *Maintenance, Repairing, Aerobic digestion, Anaerobic digestion, Treatment plants, Operating policies, Odor control, *Waste water treatment, *Water treatment facilities.

Two secondary digesters were dewatered and cleaned at the Meriden (Connecticut) Sewer Treatment Plant, causing various odor problems and revealing damaged digesters. Digester contents were spread on a nearby landfill, causing severe odor problems. Odor was controlled somewhat by spraying the beds of sludge with hydrogen peroxide, a masking agent, and some water. The primary digester contained a large amount of grit, and repairs were required to mixers, cover bolts, and pipes. The secondary digester had never been dewatered and contained a three-foot scum blanket. The scum blanket had caused broken tie rods and spider rings. Extensive repairs were required. Digesters should be dewatered every two or three years to inspect the interior, assess the amount of grit, and remove scum, floating solids, and grit. A larger, more complex tertiary treatment system is planned for addition to this plant in 1982. (Small-FRC)
W81-04267

SMALL RBCS LOGGING HOURS IN YUGOSLAVIA

A. Regent.
Water and Sewage Works, Vol 127, No 8, p 42-44, August, 1980, 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Bacteria, *Biological treatment, *Rotary biological contactors, Package plants, *Yugoslavia, *Waste water treatment, Hydrogen ion concentration, E. coli, Biological oxygen demand, Suspended solids, Dissolved oxygen.

In Yugoslavia small package plants featuring rotating biological contactors are in wide use as treatment facilities, commonly accommodating wastes from 10 to 500 people. Samples of treated effluent from 11 plants were analyzed. In a statistical analysis of the results, effluent dissolved oxygen, increase in dissolved oxygen concentration, influent pH, difference of effluent and influent pH, influent and effluent BOD₅, and BOD reduction showed normal distributions. Those parameters not showing normal distributions were water temperature, cooling of waste water, effluent pH, and influent and effluent suspended solids. Bacterial removal was sufficient so that no effluent disinfection was necessary. E. coli and many other bacteria were removed to the extent of 94.8-99.9%; nitrifying bacteria, 73.6-80.8%. (Cassar-FRC)
W81-04268

COST-SAVING AND POLLUTION-REDUCTION ASPECTS OF THE COD DETERMINATION

National Inst. for Water Research, Pretoria (South Africa).
R. Smith.
Water SA, Vol 6, No 4, p 204-206, October, 1980, 20 Ref.

Descriptors: *Chemical oxygen demand, *Costs, *Waste recovery, Waste water treatment, Mercury, *Heavy metals, Silver, Economic aspects, Water pollution control, Chemical analysis, Recycling, Chemical precipitation, Catalysts.

Large amounts of silver and mercury salts are often used by test laboratories in determining the chemical oxygen demand (COD) of water and waste water samples. Possible measures for reducing the costs of COD determination and controlling the levels of silver and mercury in the waste effluents of test laboratories were examined. When silver sulfate is used as a catalyst in COD determinations, the procedure is very costly. It was recommended that smaller amounts or cheaper grades of silver sulfate be used in COD determinations to reduce costs. The use of semi-automated or fully automated techniques for COD determinations was also suggested as a cost-effective method, as well as the adoption of recovery procedures for silver and mercury from spent COD test solutions. Silver is best removed from spent COD test solutions by precipitation as the chloride, and mercury may be removed by precipitation as the sulfide. Some precious metal refineries in South Africa will accept silver residues for recovery, while mercury residues may be sent to toxic waste disposal sites or converted to mercuric chloride for reuse. (Geiger-FRC)
W81-04269

HYDRAULIC MODEL FOR BIOLOGICAL REACTORS: APPLICATION TO ACTIVATED SLUDGE

Asian Inst. of Tech., Bangkok (Thailand).
V. A. Tuan, N. C. Thanh, and B. N. Lohani.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1931-1936, July, 1980, 8 Fig, 19 Ref.

Descriptors: *Biological waste water treatment, *Activated sludge process, *Hydraulic models, Model studies, Mathematical models, Activated sludge, Mixing.

The activated sludge process was studied with a mathematical model based on the assumption that flow is completely mixed in all component tanks of a group of tanks in series with exchange flow between adjacent component tanks. This assumption holds true only if good mixing intensity in each component tank is achieved. Numerical results were obtained, yielding a family of curves useful for determining the mixing regime in an actual reactor. Once the mixing regime is known, the performance of the partially mixed activated sludge process can be predicted using a Monod-type kinetic model to obtain rate of biomass growth and rate of substrate removal. The model is useful for depicting the mixing regime of most biological reactors presently in use. (Carroll-FRC)
W81-04272

ELECTROLYTIC FERRITE FORMATION SYSTEM FOR HEAVY METAL REMOVAL

Mitsubishi Petrochemical Co., Ltd. (Japan).
N. Nojiri, N. Tanaka, K. Sata, and Y. Sakai.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1898-1906, July, 1980, 7 Fig, 3 Tab, 3 Ref.

Descriptors: *Heavy metals, *Industrial wastewater, *Electrolysis, Chromium, Iron, Phosphates, Silicon, Coagulation, *Wastewater treatment, Sludge, Metals, Settleable solids.

An electrolytic coagulation process has been developed for removal of heavy metals from industrial wastewaters. The process consists of an electro-bath in which hexavalent chromium is reduced to trivalent chromium, polymer coagulation and settling, and formation of ferrite in the settled sludge. Ferrite sludge is separated in a magnetic separator. The chromium in ferrite sludge is not soluble in water. Phosphate and silicon dioxide are also incorporated into the ferrite sludge. Supernatant water from the settling contains very little chromium. In order to reduce the hexavalent chromium to trivalent chromium and to completely incorporate it into ferrite sludge, the atomic ratio of iron to

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chromium must be greater than five. An equation for calculating the amount of iron to be supplied for known concentrations of hexavalent chromium and phosphate and silicon dioxides in waste water is included. The process uses commercial equipment already in operation. (Carroll-FRC)
W81-04273

COMMENTS ON 'UTILIZATION, TREATMENT AND DISPOSAL OF DISTILLERY WASTE WATER' BY G. J. SHEEHAN AND P. F. GREENFIELD,
ADI Ltd., Fredericton (New Brunswick).

T. Viraraghavan.
Water Research, Vol 15, No 4, p 513, 1981. 7 Ref.

Descriptors: *Anaerobic digestion, *Anaerobic lagoons, *Industrial wastes, Effluents, Waste water treatment, Food-processing wastes, Biological filters, Stillage, India, *Distillery waste water.

G. J. Sheehan and P. F. Greenfield suggested in their paper that anaerobic upflow filters offer an unexplored possibility for the treatment of stillage (See W81-00796). The use of anaerobic filters for treating such waste waters has been explored by Suwamarat and Weyrauch (1978) and by Sundaresan et al. (1978). Two studies have also been done in India relating to the effects of iron in anaerobic lagooning of molasses distillery waste and an oxidation ditch treatment of anaerobic lagoon effluent of distillery waste. Results of other studies carried out in India are available in a series of papers presented at a seminar on distillery waste disposal methods held in 1974. (Carroll-FRC)
W81-04275

A PRELIMINARY COMPARISON BETWEEN VARIOUS GRANULAR ACTIVE CARBONS FOR WATER RECLAMATION,
National Inst. for Water Research, Pretoria (South Africa).

A. Saler, and J. L. Slabbert.
Water SA, Vol 6, No 4, p 196-203, October, 1980. 6 Fig, 13 Tab, 3 Ref.

Descriptors: *Water reuse, *Activated carbon, *Organic wastes, Adsorption, Coal, Waste water treatment, Water purification, Pilot plants, Lignite, Peat, Particle size, Chemical oxygen demand.

Eight commercially available granular active carbons were tested in laboratory and pilot plant scale studies for their ability to adsorb dissolved organics in water reclamation processes. The materials tested included bituminous coal of mesh size 8 x 30, bituminous coal of mesh size 12 x 40, peat (0.8 mm in diameter), lignite, palm kernel shell charcoal, special coal of mesh size 8 x 22, special coal of mesh size 5 x 18 and coconut shell. Iodine number, apparent density, particle and pore size distribution, abrasion resistance, hardness, ash and moisture content, and phenol and COD isotherms of the active carbon products were examined. In the preliminary tests of a long-term research project, results indicated that carbons derived from bituminous coal, peat or palm kernel shell charcoal give the best results for water reclamation purposes. These findings may be used as a basis for screening for the most suitable available carbons for the removal of dissolved organics. It was recommended that pilot scale investigations be conducted before final choices are made for adsorbents in water reclamation projects. (Geiger-FRC)
W81-04287

STARTING & OPERATING AN OXI-DITCH IN THE COLD,

Christian, Spring, Sielbach and Associates, Billings, MT.
R. L. Sanks, and J. E. Connell.
Water and Sewage Works, Vol 127, No 1, p 50-52, 66, January, 1980. 3 Fig.

Descriptors: *Oxidation ditches, *Waste water oxidation, *Temperature effects, Freezing, Performance evaluation, Ice cover, Rotors.

An oxidation ditch was first filled with sewage in the early fall as part of an upgrade of the waste

water treatment facilities in Colstrip, Montana. Nighttime temperatures typically fall to 30°F in summer and 10°F in winter. Problems encountered included icing of the rotor, poor sedimentation due to ice-clogged weirs, broken water pipes, and thick ice covering the ditch. Good operating practices were found to control or eliminate most problems. Currents and dissolved oxygen content must be simultaneously controlled to overcome underloading problems. A deeply submerged rotor can help. Rotors must be protected to keep large chunks of ice from hitting the blades. Pipes must be buried deeper than is considered safe for water pipes, as cold, slow moving sludge freezes quickly. Freezing can be prevented by purging shallow lines with air. Proper training of operators so they can cope with unusual conditions is imperative. (Small-FRC)
W81-04279

USE OF THE UPFLOW SLUDGE BLANKET (USB) REACTOR CONCEPT FOR BIOLOGICAL WASTE WATER TREATMENT, ESPECIALLY FOR ANAEROBIC TREATMENT,
Agricultural Univ., Wageningen (Netherlands).
Dept. of Water Pollution.
G. Lettinga, A. F. M. van Velsen, S. W. Hobma, W. de Zeeuw, and A. Klapwijk.
Biotechnology and Bioengineering, Vol 22, No 4, p 699-734, 1980. 9 Fig, 9 Tab, 42 Ref.

Descriptors: *Organic wastes, *Biological waste water treatment, *Anaerobic digestion, Industrial wastes, Activated sludge process, Waste water treatment, Organic loading.

The upflow anaerobic sludge blanket process was developed to treat low strength waste waters from processing foodstuffs such as sugar beet, beans, sauerkraut, potato, and skinned milk, at liquid detention times of 3-4 hours. A 6 cu meter pilot plant was capable of handling organic loads of 15-40 kg COD per cu meter per day at 3-8 hours liquid detention times. In a 200 cu meter full-scale plant it is calculated that up to 16 kg COD per cu meter per day could be treated at a detention time of 4 hours using sugar beet waste as a feed. Denitrification and acid fermentation were shown to be feasible in laboratory tests. Complete souring was obtained with sugar beet sap solution at loading rates up to 70 kg COD per cu meter per day and 3 hours detention time. Denitrification operated successfully at up to 20 kg COD per cu meter per day. (Cassar-FRC)
W81-04281

BIOLOGICALLY ACTIVE FLUIDIZED BEDS: MECHANISTIC CONSIDERATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Chemical Engineering.
K. F. Ngian, and W. R. B. Martin.

Biotechnology and Bioengineering, Vol 22, No 5, p 1007-1014, 1980. 1 Fig, 17 Ref.

Descriptors: *Activated sludge process, *Biological treatment, *Fluidized beds, *Water water treatment, Model studies, Mathematical models.

A model of a biologically active fluidized bed for waste water treatment is presented. It applies to beds with reasonably uniform particles so that stratification is avoided. The mixing of a layer of tracer particles in a liquid fluidized bed is described by a partial differential equation involving tracer particle concentration, time, diffusional mixing coefficient in the axial direction, and the axial coordinate. This equation is solved for a biologically active fluidized bed with bed height 100 cm, particle diameter 0.1 cm, superficial liquid velocity 0.6 cm per sec, bed voidage 0.6, liquid density 1 g per cu cm, liquid viscosity 0.01 g per cm per sec, Reynolds number 6, and Pecllet number 0.1, giving a diffusional mixing coefficient of 1 sq cm per sec. Plotting the calculated results shows that the time required for complete dispersion of tracer particles is less than 10 minutes. (Cassar-FRC)
W81-04282

RELATIONSHIP BETWEEN BULKING AND PHYSICOQUIMICAL-BIOLOGICAL PROPERTIES OF ACTIVATED SLUDGES,

Rome Univ. (Italy). Physical Chemistry Inst.
M. Beccari, P. Mappelli, and V. Tandoi.
Biotechnology and Bioengineering, Vol 22, No 5, p 969-979, 1980. 3 Fig, 2 Tab, 31 Ref.

Descriptors: *Activated sludge process, *Sludge bulking, *Bulking sludge, Flocculation, Retention time, Polymers, Waste water treatment.

A correlation between sludge volume index (XVI) and biopolymer content (exocellular polymer, ECP) was observed during laboratory scale studies of bulking in the activated sludge process using acidified peptone and meat extract as a feed. During the first experiment (hydraulic retention time, 6 hours and sludge age, 7 days) every decrease or increase in SVI was matched by a decrease or increase in ECP. In the second experiment (hydraulic retention time varied from 6 to 12 hours, and sludge age, 4.5 days) SVI and ECP clashed, increases in one corresponding to decreases in the other and vice versa. This information may be used to identify bioflocculation process mechanisms in order to optimize plant operating conditions. A method for determining ECP indirectly by measuring COD and total organic carbon values proved faster and equally accurate for ECP determination as the gravimetric method. (Cassar-FRC)
W81-04283

TOXIC CONTROL—THE TREND OF THE FUTURE,
CH2M/Hill, Milwaukee, WI.
G.W. Foess, and W. A. Ericson.
Water and Wastes Engineering, Vol 17, No 2, p 21-24, 27, February, 1980. 5 Tab, 5 Ref.

Descriptors: *Heavy metals, *Organic compounds, *Metals, *Legislation, Industrial wastes, Municipal wastes, Waste water treatment, Water pollution control, Toxins, Regulations, Water quality, Ion exchange, Activated sludge, Chemical precipitation, Disinfection, Oxidation, Coagulation, Activated carbon, Pollutants, Chelation, Osmosis, Incineration, Reverse osmosis, Cadmium, Soil amendments.

A discussion of control of toxic pollutants, especially heavy metals and organics, in municipal waste water includes reasons for removal, regulatory requirements, nature of contaminants, fate during waste water treatment, and performance of removal mechanisms. Primary sedimentation removes an average of 20-30% heavy metals and some of the organics. Activated sludge has a high affinity for metals, recovering 40-60%, and some organics, removing as high as 60%. Chemical oxidation can destroy toxic organics, but possible produce additional undesirable compounds. Chemical precipitation and coagulation reduces many metals in raw waste water to less than 0.1 mg per liter, but the process is not effective for the lower ranges in activated sludge effluent. Activated carbon adsorption is especially effective for organics removal. Chelation with EDTA or starch xanthate-PVBTMAC complex extracts metals at original levels of 500-2,000 mg per liter to produce residual levels below 0.01 mg per liter. Ion exchange processes are available for both metals and organics removal. Methods not in common use for various reasons are reverse osmosis and wet-air oxidation. Incineration is expected to increase in importance in the future. (Cassar-FRC)
W81-04286

TAKE ADVANTAGE OF NATURAL DEPRESSIONS,
D. E. Phillips.
Water and Wastes Engineering, Vol 17, No 7, p 45, 46, 51, July, 1980. 2 Fig, 2 Tab.

Descriptors: *Aerated lagoons, *Waste water facilities, *Sludge treatment, Construction costs, Effective capacity, Treatment plants, Waste water treatment, Natural depressions, Manchester, *Vermont.

At the Manchester, Vermont, waste water treatment plant, two natural depressions are used as aeration lagoons. The natural design provides tremendous expansion capability and is cost effective.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

The natural bowls provide ample space for the operator to add an additional seven feet to the liquid level simply by raising the effluent telescoping valve. The waste water in Manchester is primarily domestic and is collected through a network of gravity sewers. Once in the lagoons, the water is continuously mixed and aerated by bubbles discharged from the aeration system. The sludge accumulates very slowly at the bottom of the lagoons and continues to digest aerobically at its surface and anaerobically within its depths. Designers anticipate that the sludge will only need to be removed once every 15 to 20 years. Since sludge handling has been virtually eliminated, operational savings of about 40% over conventional systems are expected. Based on the five-year design, the effluent will contain a maximum of 30 mg/liter BOD and suspended solids. (Small-FRC W81-04297)

DESIGN FEATURES GAC & MORE,

Stearns and Wheeler, Cazenovia, NY.
W. O. Lynch, and L. R. Potter.
Water and Wastes Engineering, Vol 17, No 7, p 40-41, 54, July, 1980. 2 Fig, 4 Tab.

Descriptors: Treatment plants, *Chemical coagulation, *Chlorination, *Waste water treatment, Municipal waste water, Activated carbon, Flexibility, Ammonia, Performance evaluation, New York, Cortland, Waste water facilities.

The Cortland, New York, wastewater treatment plant was upgraded by using chemical coagulation, GAC (granular activated carbon) adsorption and filtration, and breakpoint chlorination to meet the 2,900 lb/day TOD (total oxygen demand) and 440 lb/day ammonia limitation. Existing primary settling tanks were converted to chlorine contact tanks. Polymer, ferric chloride, and alum are used as coagulants, and breakpoint chlorination can be used for ammonia removal before or after the activated carbon adsorption-filtration process. Eight carbon columns can operate as eight columns in parallel, as four sets of two columns in series, or as a combination of both series and parallel columns. Maximum operational flexibility is provided. During one month's operation of the carbon adsorption-filtration process, the final plant effluent showed an average of 94% reduction in BOD5 and an average of 98% reduction in suspended solids. This resulted in a plant effluent with an average BOD5 concentration of 11.6 mg/liter and an average suspended solids concentration of 11.9 mg/liter. (Small-FRC W81-04298)

5E. Ultimate Disposal Of Wastes

EVALUATION OF HOT ACID TREATMENT FOR MUNICIPAL SLUDGE CONDITIONING,

Abcor, Inc., Wilmington, MA. Walden Div.

K. J. McNulty, A. T. Malarkey, R. L. Goldsmith, and H. A. Fremont.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144446, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-096, August 1980. 174 p, 47 Fig, 43 Tab, 25 Ref, 2 Append.

Descriptors: *Sludge conditioning, *Heavy metals, *Sterilization, *Hot acid treatment, Sludge drying, Cadmium, Zinc, Nickel, Cost analysis, Land disposal, Municipal waste water, Dewatering.

Land application is an attractive method for final disposal of sludge solids. However, this method has not been fully exploited because of the potential environmental risk the concentrations of heavy metals in sludge present. Bench-scale tests were conducted to evaluate the technical and economic feasibility of the hot acid process for stabilization/conditioning of municipal sewage sludge. This process involves acidification of the sludge (pH 1.5-3) and heating to temperatures below boiling (approximately 95 degrees C). Test results indicate that the process improves the dewaterability of the sludge, destroys essentially all pathogens, and preferentially solubilizes certain heavy metals relative

to nitrogen and organics. The process demonstrated the potential for good solubilization and removal of toxic heavy metals including cadmium, zinc, and nickel with minimal solubilization of nitrogen. Thus the hot acid process improves the desirability of sludge solids for land application. A preliminary economic analysis of the process indicates that it is quite cost-competitive with alternative stabilization/conditioning processes. (Moore-SRC) W81-04002

WASTE WATER SOLIDS UTILIZATION ON LAND DEMONSTRATION PROJECT.

Ocean County Sewerage Authority, Bayville, NJ. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111072, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-090, August 1980. 164 p, 36 Fig, 26 Tab, 6 Ref.

Descriptors: *Municipal wastes, *Land disposal, *Sludge disposal, *Solid waste disposal, *Environmental effects, Soil types, Groundwater pollution, Groundwater movement, Crop production, Air pollution, Heavy metals, Monitoring, Wildlife.

271s report is a condensed version of a much larger study and presents in summary form the guidelines, limitations, and environmental changes associated with land applications of digested municipal waste water solids under the conditions of the study. The environmental impact on sand and sandy loam soils at various application rates was investigated. The study was conducted over a four-year period, but sludge was applied during the first three years. Some of the salient considerations were the effect of sludge on groundwater quality, groundwater movement, crop production, wildlife, microbial aerosols, odor, soil properties, crop management, heavy metal uptake, and monitoring needs. Depending on the soil, sludge loading rates of 22.4 and 44.8 ton/ha/year are possible. Crop production can be enhanced by potassium fertilization, irrigation and good management practices. Heavy metal uptake by plants is not a problem. The disposal area should be fenced to keep wildlife out, be surrounded by a buffer zone to control odors and aerosols, and be monitored on a regular and continuing basis. (Brambley-SRC) W81-04006

INFORMATION PROGRAMS AFFECT ATTITUDES TOWARD SEWAGE SLUDGE USE IN AGRICULTURE,

Ohio Farm Bureau Development Corp., Columbus.

N. M. Musselman, L. G. Welling, S. C. Newman, and D. A. Sharp.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-107112, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-103, July 1980. 58 p, 19 Tab, 4 Ref.

Descriptors: *Land disposal, *Sludge disposal, *Municipal wastes, *Farms, *Attitudes, Education, Communication, Urban areas, Rural areas, Public opinion, *Ohio.

The attitudes of Ohio farmers, rural nonfarmers, urban and suburban residents toward land application were investigated and the influence of educational meetings on those attitudes determined. The general methodology involved: a survey of community knowledge and attitudes regarding sludge and its application to farmland; development and implementation of a land application educational program; assessment of the effectiveness of the educational programs on participants' knowledge and attitudes. Females are much more negative than males in their reaction to the use of sludge. Farmers who have used sludge are more favorable to its use than those who have not used it. People who know the definition of sludge have a more favorable reaction to its use. Educational meetings proved to be an effective means of improving participants' attitudes and acceptance of land application. However, even with extensive meeting publicity, only a small number of community members will attend such meetings. Land application is

not likely to become a topic of great interest until a land application program is imminent. Obviously, there is still a need to increase community awareness of the facts about land application. If educational meetings are not the most efficient way, it is suggested that more efficient methods may be informational pamphlets, films and slide programs, and speakers' bureaus. (Brambley-SRC) W81-04007

SURVIVAL OF ENTEROVIRUSES AND COLIFORM BACTERIA IN A SLUDGE LAGOON, Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.

S. R. Farrah, G. Bitton, E. M. Hoffmann, O. Lanni, and O. C. Pancorbo.

Applied and Environmental Microbiology, Vol 41, No 2, p 459-465, February, 1981. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Viruses, *Lagoons, *Sludge, Soil amendments, Path of pollutants, Florida, Test wells, Coliforms, Ultimate disposal, Disposal, *Sludge disposal.

The fate of enteroviruses during lagooning and land application of aerobic and anaerobic sludge was studied in the north Florida climate. During active addition of sludge to the lagoons, enterovirus levels in sludge were highest (about 80-50% tissue culture infective dose units per gram of sludge), dropping off during a 2 month period to a negligible level and increasing when sludge addition was resumed. Changes in fecal coliform numbers paralleled the virus changes. Overlying water samples were similarly high in viruses during and after sludge addition, but very low during periods of no activity. No viruses were present at any time in water wells near the lagoons as measured during a 1-year bimonthly monitoring program. When sludge was applied to land, viruses were still detectable after 9 days of environmental exposure. Controlled experiments showed that under hot, wet weather conditions 35 days were required for a 4 log 10 reduction of poliovirus-1 or echovirus-1; 21 Days during hot, dry weather. During the first 10 months of the study, polioviruses were 90% of the total viruses, and in the second 10 months of the study, polioviruses were 90% of the total viruses, and in the second 10 months echoviruses and Coxsackieviruses were more common, 60% of the total virus isolates. (Cassar-FRC) W81-04105

EFFLUENT CREATES AN OASIS IN NEVADA, Clark County Sanitation District, Las Vegas, NV. D. Tusack-Gilmour.

Water and Wastes Engineering, Vol 17, No 9, p 22-24, 56, September, 1980. 2 Fig.

Descriptors: *Wildlife, *Wetlands, *Parks, Recreation, *Waste water disposal, Waste water treatment, Disposal, Ultimate disposal, *Las Vegas Wash, Nevada, Flood control, Effluents, Ecology, Land use.

The Las Vegas Wash has been transformed from a desert to a marshy wetlands harboring many species of birds, mammals, and plants because two major sewage facilities discharge their effluent into the basin. Increasing flow has caused erosion and headcutting in this wildlife habitat and recreational area. The future of the Wash presents many problems because conflicting uses are proposed. Some of these alternatives are a wetlands park, discharging effluents further downstream, construction of a pipeline to bypass the area (favored for salinity control), and flood control projects. At present, the concept of a county wetlands park is strengthening. (Cassar-FRC) W81-04156

SLUDGE MANAGEMENT AND ENERGY INDEPENDENCE, Monroe County Div. of Pure Waters, Rochester, NY.

G. C. McDonald, T. Quinn, and A. Jacobs. Journal of the Water Pollution Control Federation, Vol 53, No 2, p 190-200, February, 1981. 5 Fig, 9 Tab, 1 Ref.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

Descriptors: *Sludge disposal, *Costs, Composting, Sludge drying, Waste management, Land disposal, Waste recovery, Recycling, Economic aspects, Waste water treatment, *Monroe County, New York.

In 1977, the Monroe County (New York) Division of Pure Waters began a study to develop a long-term plan for cost-effective, environmentally responsible sludge disposal. Thirty-one alternatives were formulated for processing sludge produced at the Frank E. Van Lare Plant. The alternatives involved direct land application, composting to produce a soil conditioner, and various thermal reduction techniques. Costs of each method were evaluated on the basis of equivalent annual costs over a 20-year planning period. All land applications of liquid sludge were eliminated from further screening because these methods were too high in cost. A sludge management plant was devised consisting of four vacuum filters with continuous belt filter presses capable of obtaining 25% sludge cake solids. When the plan is implemented, the total installed operable dewatering capacity will be 163.4 metric tons/day. Two 11-hearth furnaces will be modified to allow operation in a starved air combustion mode using refuse-derived fuel. The pyrolytic gases produced in the multiple hearth furnace will be burned in an afterburner as part of a waste-heat recovery system. The plant modifications will be implemented in three stages and will cost over \$4.7 million. (Geiger-FRC)
W81-04193

COMPOSTED, DIGESTED SLUDGE AS A MEDIUM FOR GROWING FLOWERING ANNUALS,
Kansas State Univ., Manhattan. Dept. of Horticulture.

R. D. Wootton, F. R. Gouin, and F. C. Stark.
Journal of the American Society for Horticultural Science, Vol 106, No 1, p 46-49, January, 1981. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Sludge disposal, *Soil amendments, *Plant growth, Ultimate disposal, Disposal, Crop response, Toxicity, Heavy metals, Soil structure.

No toxicity symptoms from soluble salts or heavy metals and no nutrient deficiency symptoms were observed in flowering annual plants grown in sludge-compost media of various particle sizes. Greatest shoot dry weight was seen in petunias, zinnias, and marigolds grown in the finest medium, No. 8 Sieve, compost particles between 0 and 2.4 mm. Screened, composted sludge has significant value to horticulturists growing crops in containers. (Cassar-FRC)
W81-04187

DEGRADATION OF CIS-PERMETHRIN IN SOIL AMENDED WITH SEWAGE SLUDGE OR DAIRY MANURE,

Atlantic Research Corp., Alexandria, VA.
R. C. Doyle, D. D. Kaufman, G. W. Burt, and L. Douglass.

Journal of Agricultural and Food Chemistry, Vol 29, No 2, p 412-414, March-April, 1981. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Soil amendments, *Waste disposal, *Microbial degradation, Sludge, Sludge disposal, Sludge utilization, Insecticides, Permethrin, Pesticides, Degradation, *Manure, Farm wastes, Dairy industry.

Laboratory degradation tests were carried out on radioactively-labeled cis-permethrin in sewage sludge and dairy manure amended Matapeake silt loam to assess the effects of organic material on the decomposition of pyrethroid insecticides in soil. Dairy manure and sludge were applied to the soil at rates of 0, 50, and 100 metric tons/hectare. After leaching to remove excess soluble salts and incubation for 15 days at 30 degrees, the labeled insecticide was added at 1 ppm. Total carbon dioxide and labeled carbon dioxide evolution were measured routinely throughout the 60 day incubation period at 25 degrees. After incubation, the distribution of labeled product was determined by soil extraction and thin layer chromatography. Incorporation of

50 or 100 metric tons/hectare of dairy manure and sewage sludge increased permethrin breakdown by 64 or 134%, and 87 or 149%, respectively. Carbon dioxide recovery patterns showed that microbial metabolism was responsible for a significant amount of permethrin degradation in waste-amended soils after an extensive lag period. A significant amount of the radioactive material extracted from waste-amended soils was distributed in several relatively polar, unidentified compounds. (Geiger-FRC)
W81-04193

EXPERIMENTAL STUDIES ON THE DEWATERING OF MIXED SEWAGE SLUDGE,
North West Water Authority, Warrington(England).
E. I. Clark.
Progress in Water Technology, Vol 12, No 5, p 359-386, 1980. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Dewatering, *Sludge thickening, *Chemical treatment, Dissolved oxygen, Sludge drying, Waste water treatment, Treatment plants, *Sludge disposed.

Laboratory scale, pilot scale, and plant dewatering studies of mixtures of sludges from four treatment plants were performed. The purpose was to determine the feasibility of dewatering on one site the sludges produced at the four plants, either singly or in a variety of combinations. Conditioners commonly used in the United Kingdom were evaluated, including aluminum, ferrous sulfate and lime, ferric chloride with and without lime, and polyelectrolytes as recommended by the manufacturers. It was possible to consistently dewater mixtures of the four sludges to produce cakes containing 30 to 40% dry solids content using inorganic conditioning agents and filter presses. Pressures higher than the 7 bar normally used in the United Kingdom were used. A typical filtrate from the full-scale plant had a BOD of 1000 mg/liter after neutralization. Further work should investigate the results obtainable with in-line dosing of polyelectrolytes. (Small-FRC)
W81-04207

COLIFORM REDUCTION IN DOMESTIC SEWAGE BY LIME TREATMENT PRIOR TO MARINE DISPOSAL,
Hawkesley (Watson), High Wycombe(England).
S. D. Myers, M. J. Kneen, and R. Barnard.
Progress in Water Technology, Vol 12, No 5, p 455-458, 1980. 2 Ref.

Descriptors: *Coliforms, *Lime, *Hydrogen ion concentration, *Waste water treatment, Colloids, Chemical precipitation, Sewage bacteria, *Waste water disposal.

Laboratory experiments were carried out to determine coliform bacteria reductions which could be expected in the effluent as a result of raising the pH of sewage by lime dose. The alteration in coliform bacteria concentration showed great variability, ranging from more than 50% removal to slight increases in bacterial count. This variability was probably due to variability in the character of the sewage, particularly colloidal matter content and settleability characteristics. Below pH 10.0, almost all removal is accounted for by the aggregation of bacteria and precipitation together with coagulated colloidal material. Above pH 10.5, bacterial mortality is a more significant factor during settlement. Recoveries of bacteria from re-suspended sediments fall rapidly above pH 11.0. At pH 12, only 2% of the original raw sewage count is obtained. Lime doses to achieve pH values above 10.0 are necessary to obtain significant reductions in coliforms. (Small-FRC)
W81-04209

LIME STABILIZATION,
Caiglon Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 5D.
W81-04238

PAPER MILL AND CHEMICAL PLANT SLUDGE AIDS RECLAMATION,

R. Simon, and P. White.
Industrial Wastes, Vol 27, No 1, p 21, 25, January/February, 1981. 2 Tab.

Descriptors: *Pulp and paper industry, *Sludge, *Land reclamation, Waste water treatment, Land disposal, Florida, Industrial wastes, Waste water management.

The city of Port St. Joe, Florida, has a population of about 4,200 people, and most of the effluent into the waste water treatment plant comes from a paper mill and a chemical company. The average influent on a typical day contains 49,035 lb BOD and 62,241 lb suspended solids (SS) from the mill, 14,187 lb BOD and 8,112 lb SS from the chemical plant, and 537 lb BOD and 570 lb SS from the city. The abundance of wood fiber and the absence of heavy metals and pesticides in the sludge makes the final product suitable for land reclamation. The plant offers primary and secondary waste water treatment. The average sludge production is 89.3 tpd (wet basis), with 17.1 tons volatile solids per day, 18.7 tons of lime solids, and two tons of grit on a bone-dry basis. (Baker-FRC)
W81-04299

5F. Water Treatment and Quality Alteration

MANGANESE REMOVAL FROM WATER BY PRECIPITATE FLOTATION TECHNIQUE,
Rhode Island Univ., Kingston. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W81-03958

HINDRANCE OF COLIFORM RECOVERY BY TURBIDITY AND NON-COLIFORMS,
Delaware Univ., Newark.
For primary bibliographic entry see Field 5A.
W81-04004

OXIDATION OF WATER SUPPLY REFRACTORY SPECIES BY OZONE WITH ULTRAVIOLET RADIATION,

North Texas State Univ., Denton.
W. H. Glaze, G. R. Peyton, F. Y. Huang, J. L. Burleson, and P. C. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-107104, Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-110, August 1980. 320 p, 39 Fig, 37 Tab, 196 Ref, 6 Append.

Descriptors: *Water treatment, *Ultraviolet radiation, *Ozone, *Trihalomethane precursors, Cost analysis, Chloroform, Water pollution, Bromodichloromethane, Tetrachloroethylene, Hexachlorobiphenyl.

The use of ozone with ultraviolet radiation was studied as an advanced treatment process for the removal of micropollutants and trihalomethane precursors from drinking water. The model compounds chloroform, bromodichloromethane, tetrachloroethylene and 2,2',4,4',6,6'-hexachlorobiphenyl were treated with ozone/UV as well as UV and ozone individually in both highly purified water and lake water. Kinetic rate expressions which express the dependence of the reaction rate on ozone dose rate, UV intensity and substrate concentration were developed. The trihalomethane formation potential of a natural lake water was monitored as a function of ozone/UV treatment time. Products resulting from the ozone/UV treatment of some model compounds and lake water were studied. The kinetic data were submitted to a subcontracted consulting engineering firm for full-scale process design and a treatment cost estimate. Costs for a 1-50 Mgal/day plant to remove 90% of 100 microgram/L of chloroform and bromodichloromethane and 20 microgram/L of tetrachloroethylene were \$0.063 - 0.16 per thousand gallons. Costs for removal of 90% of the trihalomethane formation potential from lake water were \$0.099 - 0.20 per thousand gallons. (Author's abstract).

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F—Water Treatment and Quality Alteration

W81-04005

PRESERVATION OF AQUEOUS SYSTEMS WITH ALPHA-CHLORO-BETA-AMINOCROTONAMIDE,

Giavadas Corp., Clifton, NJ. (Assignee); and Hoffmann-La Roche, Inc., Nutley, NJ. (Assignee). H. A. Brandman, M. Margowitz, and D. L. Coffen. U.S. Patent No. 4,217,363, 4 p, 4 Tab, 5 Ref; Official Gazette of the United States Patent Office, Vol 992, No 2, p 652, August 12, 1980.

Descriptors: *Patents, *Water treatment, *Industrial water, *Cooling water, Bacteria, Chemical reactions, Organic compounds, Fungi, *Antimicrobial agents.

A number of aqueous systems are susceptible to antimicrobial growth. The growth of bacteria and fungi in such systems can be a serious problem if not properly controlled. For example, industrial aqueous systems are susceptible to slime formation which, if unchecked, can cause severe maintenance and production problems. There is a continuing need to provide effective and economical antimicrobial agents which protect these systems. The finding of this invention is that compositions and methods utilizing alpha-chloro-beta-aminocrotonamide provide effective control of such microbial growth. It has been found effective against a broad spectrum of bacteria including gram positive bacteria, gram negative bacteria and fungi. The breadth of such activity is illustrated in the examples. (Sinha-OEIS)

W81-04081

SEMPERMEABLE MEMBRANES OF COPOLYAMIDES,

Bayer A.G., Leverkusen (Germany, F.R.). (Assignee).

For primary bibliographic entry see Field 3A.

W81-04083

METHOD AND APPARATUS FOR PURGING DISINFECTING HIGH PURITY WATER DISTRIBUTION SYSTEMS,

For primary bibliographic entry see Field 5G. W81-04096

COAXIAL HYDROMAGNETIC DEVICE FOR HYDRAULIC CIRCUITS CONTAINING CALCIUM AND MAGNESIUM IONS,

Hydromagnetics, Inc., Solvang, CA. (Assignee). W. N. Shalhoub, C. W. Chenchick, and A. F. Kaspau.

U.S. Patent No. 4,216,092, 7 p, 11 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 220, August 5, 1980.

Descriptors: *Patents, *Water treatment, *Industrial water, *Scaling, Equipment, Electric fields, Inhibition, Turbulence, Mixing, Magnetic fields, Hydromagnetic devices.

The invention provides a coaxial hydromagnetic device which not only inhibits the adhesion of calcium and magnesium scale to heat transfer surfaces, boiler walls and the like, but also initiates auto-nucleation of scale within the bulk of water passing through the device. Suitably shaped and suitably placed permanent magnets are arranged to produce optimized interactions between the electrically conductive flowing water which is to be conditioned and the generated electrical potentials and currents, the effect of the structure being to shift the usual precipitation of scale from heat transfer surfaces to precipitation within the water itself. The structure produces regions of maximum magnetic intensity coincident with annular constrictions in a conduit through which the water flows. The combination of intense magnetic fields coupled with increased fluid velocity due to the constrictions formed in the conduit produce electrical voltages which are greater than the activation potentials required for auto-nucleation. The direction of magnetic and electric field vectors within the structure are oriented in a manner to the flow of water; this orientation being preferably perpendicular. Low velocity regins immediately

downstream of the constrictions produce turbulence and mixing, thereby increasing precipitation of scale. (Sinha-OEIS)

W81-04097

ERIE COUNTY PLANT CUTS CONSTRUCTION COSTS,

Pirnie (Malcolm), Inc., White Plains, NY.

G. P. Westerhoer. Water and Wastes Engineering, Vol 17, No 1, p 12-18, January, 1980. 1 Fig, 2 Tab.

Descriptors: *Clarifiers, *Filtration, *Treatment plants, Drinking water, Construction costs, Costs, Water treatment facilities, *Buffalo, New York.

The Jerome D. Van de Water Water Treatment Plant in Buffalo, New York, makes extensive use of tube clarifiers and a specially designed filter media and filtration system to produce water of improved quality. After extensive pilot and plant-scale research this plant was designed to accommodate changing raw water supply quality and to provide continuous and economical operation. Treatment facilities consist of chemical treatment, rapid mixing, coagulation and sedimentation, filtration, and finished water storage. Plant facilities were designed for a future expansion to 150 mgd. The plant currently processes 65 mg. The entire complex, including river intake, raw water pumping station and transmission main, the treatment plant, and the sludge treatment and disposal facility, was constructed for \$42 million. The facility's construction won an award for excellence in project design from the New York Society of Civil Engineers. (Small-FRC)

W81-04153

WEIGH THE ORGANICS CONTROL ALERTIVES,

L. J. DiGennaro.

Water and Wastes Engineering, Vol 17, No 9, p 36, 38, 40, 42, September, 1980.

Descriptors: *Trihalomethanes, *Organic compounds, Activated carbon, *Water treatment, Chlorination, Adsorption, *Drinking water.

Several speakers at the American Water Works Association Atlanta, Georgia, conference discussed trihalomethane and organic chemicals in drinking water. Granular activated carbon, commonly used to remove these contaminants, was the subject of several papers, particularly regeneration and pore size. The newer powder activated carbon process received mixed reviews from researchers. Methods of preventing trihalomethane formation included ozone disinfection, shortening chlorine contact time, and addition of other chemicals to the chlorination process. (Cassar-FRC)

W81-04157

THE USE OF DRINK VENDING MACHINES WITH CONTAMINATED WATER SUPPLIES: THE POTENTIAL RISKS TO PUBLIC HEALTH,

North West Water Authority (England). Ribble Div.

A. F. Godfree, M. Bosley, and F. Jones.

Journal of the Institution of Water Engineers and Scientists, Vol 35, No 1, p 80-87, January, 1981. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Public health, *Vending machines, *Bacteria, Risks, Chloriforms, Temperature, Heat, Beverages, Water pollution control, Water quality, Pollutants, Microorganisms, Water temperature.

A vending machine dispensing hot drinks produced a bacteriologically satisfactory product from heavily polluted water (total coliforms 29,000 per 100 ml), providing that the temperature did not fall below 70C. This study simulated conditions which could prevail during a water emergency. Waters tested were: potable water with 0.1% sewage effluent, river water with microbial contamination, and river water with 0.1% sewage effluent. Recommendations were: a heater adequate for periods of heavy demand, equipment should not be switched off, the machine should be allowed to reach oper-

ating temperatures before drinks are removed, heater tank design should prevent short-circuiting of water, and a safety light to indicate a water temperature below the safe 70C. (Cassar-FRC)

W81-04164

ALTERNATIVE PROCESSES FOR SMALL WATER TREATMENT PLANTS,

H. M. Mueller, and W. R. Conley.

Water and Pollution Control, Vol 119, No 2, p 12-15, February, 1981. 3 Fig, 6 Ref.

Descriptors: *Water treatment, *Filtration, *Pack- age plants, *Capital costs, Costs, Tube settlers, Sedimentation, Coagulation, Flocculation, Turbi- dity.

Many processes are available for small water treatment plants. Most are variations of coagulation/flocculation/sedimentation/filtration process for treatment of color and turbidity. Tube settlers are efficient in smaller tanks. Mixed media filters, composed of coal, sand, and ilmenite or garnet, can handle high turbidity and flow rates and produce water of highest clarity. Direct filtration requires less equipment and has lower capacity and operating costs than other methods. No flocculation is required, and less sludge accumulate. This method is best used for water containing up to 15 turbidity and color units. Water containing over 50 turbidity and color units requires further pilot plant and laboratory studies if direct filtration is used. A graph is used to depict relative capital costs in relation to capacity for three systems: conventional, package plant, and direct filtration. Generally, direct filtration requires least capital expenditures, package plants second, and conventional systems, most. (Cassar-FRC)

W81-04186

THM'S IN DRINKING WATER,

Environmental Protection Agency, Washington, DC. Office of Drinking Water.

J. A. Cotruvo.

Environmental Science and Technology, Vol 15, No 3, p 268-274, March, 1981. 6 Tab, 25 Ref.

Descriptors: *Organic compounds, *Potable water, *Chlorination, *Regulations, Trihalomethanes, Water purification, Water quality, Toxicity, Monitoring, Public health, Costs, Chloroform, Disinfection, Activated carbon, Water analysis.

A comprehensive presentation on trihalomethanes (THM) in drinking water discusses several reasons for EPA's decision to regulate levels: drinking water is the major source of THM exposure to humans; THMs may be present in high concentrations; control of formation during water treatment (chlorination), removal from water, and monitoring is feasible; and THMs are indicators of other halogenated, potentially harmful compounds. A summary of THM regulations lists the monitoring and reporting requirements. Exposure may be minimized by using disinfectants which do not generate THMs in water, by reducing precursor concentrations prior to chlorination, and by removing THM after formation. Average annual costs per residence for removing excess THM from regulated systems (serving more than 10,000 people) are estimated at \$1.40. Two surveys of drinking water in 80 and 113 cities respectively revealed an average total THM concentration of 0.053 to 0.117 mg per liter. Chloroform was found in the largest amounts, up to 75% of total THM. Most chloroform toxicity and metabolism studies have used high doses; mammalian responses include central nervous system effects and damage to kidneys and liver. Chloroform-induced teratogenesis and carcinogenesis have been reported, and similar studies on the brominated haloforms are underway. Although the levels of THM in drinking water are generally very low, it is not difficult or expensive to reduce the contaminant levels. The goal is to provide drinking water as free of adulterants as technology permits. (Cassar-FRC)

W81-04195

CONTROL OF TASTE AND ODOR IN SURFACE WATER SUPPLY,

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Quality Control—Group 5G

Water Treatment and Pollution Control, Waco, TX.
M. D. Meadows.
Southwest and Texas Water Works Journal, Vol. 62, No. 9, p 8-10, 12-13, December, 1980. 6 Ref.

Descriptors: *Surface waters, *Taste, *Odor, Water quality, Algae, Reservoirs, *Water treatment, Lakes, Chlorination, Water distribution, Corrosion, Pipes, Sampling, Algaecides, Activated carbon, Aeration, Ozone, Bacteria, Organoleptic properties, Water pollution effects, Potable water, Taste-producing algae, Odor-producing algae, *Odor control.

There are many causes of taste and odor in surface water supplies. Lakes are subject to drainage from agricultural chemical areas, industrial parks, oil fields, trash dumps, and other places. Algae cause taste and odor problems upon decomposition and reproduction. The treatment plant itself can be a major site of problems—chlorination, misapplication of chemicals, sludge buildup, cross connections, improper coatings or paint on equipment, and foreign material (animals, etc.) in open storage tanks. In the distribution systems, pipe corrosion, temperature over 85 degrees, biological growth (slime, bacteria, algae spores), dead end mains, and stray electrical currents can produce unpleasant tastes and odors. Sometimes problems are customer-induced: oversize service lines with stagnant water, pipe joint fluxes, faulty water conditions and filters, ice cubes which have absorbed refrigerator odors, and sediment in tanks and traps. Many methods are available for controlling taste and odor in water, including proper sampling and monitoring, use of algaecides in the reservoir, aeration or destratification, activated carbon treatment, sludge drawoff, permanganate treatment, ozonation, chlorination, pH adjustment, and eliminating dead ends and low flows in the distribution system. (Cassar-FRC)
W81-04233

INNOVATIVE TECHNIQUES FOR WATER TREATMENT PLANT CONTROLS, Bristol Babcock, Inc., Waterbury, CT.
K. E. Jasper.
Southwest and Texas Works Journal, Vol. 62, No. 7, p 12-13, October, 1980.

Descriptors: *Control systems, *Automatic control, Computers, Instrumentation, Mechanical control, Water treatment, *Water treatment, *Water treatment facilities.

A history of control in water treatment plants begins with manual and mechanical control (pressure gauges and staff gauge level indicators). During the 1950's a noticeable shift to pneumatic controls took place. The slow response and high cost of pneumatic systems caused a gradual replacement by electronic instruments as these became available. The microcomputer, which entered the scene in 1976, proved cost effective, time saving, versatile, and able to perform automatic control and routine tasks. (Cassar-FRC)
W81-04239

LOUISIANA SEES TO TRAINING IN ADVANCE OF CERTIFICATION, Peoples Water Service Co., Inc., Bastrop, LA. For primary bibliographic entry see Field 9A.
W81-04240

'COUNTRY WATER'...FROM HOLLOW LOGS TO 1,062 SYSTEMS, Louisiana Rural Water Association, Alexandria, R. L. Lawrence.
Southwest and Texas Water Works Journal, Vol. 61, No. 11, p 8, February, 1980.

Descriptors: *Louisiana Rural Water Association, *Training, Water quality, Water treatment, Safe Drinking Water Act, Organizations, *Water supply systems, Operators and maintenance, Louisiana, Rural areas, Small towns.

The membership of the Louisiana Rural Water Association, incorporated in 1978, is limited to

systems serving 5,000 or fewer people. It provides technical assistance and training to solve both emergency problems and chronic operating problems. Training is conducted during one-to-one sessions and workshops at selected locations. During fiscal year 1979, the Louisiana Rural Water Association assisted 132 water systems and trained 258 operators. Its goal is to improve the existing deficiencies in rural water systems. (Cassar-FRC)
W81-04244

UNDERSTANDING WATER QUALITY, Oklahoma State Univ., Stillwater. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W81-04245

THE SCRANTON STORY, Rogers and Associates, Inc., Fort Smith, AR.
A. L. Prieur, Jr.
Southwest and Texas Water Works Journal, Vol. 62, No. 1, p 18, 32, April, 1980.

Descriptors: *Water supply development, *Public health, *Wells, Water distribution, *Scranton, Arkansas, Rural areas, Alternative water use, Dry wells, Water transfer, Pipelines.

In the summer of 1976, the only well supplying water to the City of Scranton, Arkansas, population 250, failed. After several months a new well was drilled, but water quality was very poor (high alkalinity, total solids, and cadmium). Several alternatives were ruled out: further groundwater sources, the Arkansas River, and connection to an existing system. The problem was solved by obtaining a \$500,000 grant, under regulations covering imminent threat to public health, to connect with the Gray Rock Water Association via a 53,000 ft long 8 inch diameter water line. Construction was expected to be complete for the summer of 1980. (Cassar-FRC)
W81-04246

WATER AND SANITATION PROBLEMS IN INDIA, California State Univ., Long Beach.
For primary bibliographic entry see Field 5D.
W81-04256

BEWIL BRIDGE TREATMENT WORKS, Mid Kent Water Co. (England).
P. D. Wilkinson, P. M. Bolas, and M. F. Adkins. Journal of the Institution of Water Engineers and Scientists, Vol. 35, No. 1, p 47-58, January, 1981. 3 Fig.

Descriptors: *Flotation, *Pilot plants, *Dissolved air flotation, *Water treatment, Water purification, Algae, Bewl Bridge Treatment Works, Potable water, Nutrients, Separation techniques, *Kent, England.

The Bewl Bridge potable water treatment works was built in Kent, England, to treat water from a eutrophic lowland impoundment, part of the River Medway Scheme. This water is moderately soft, with high nutrient content from the farmland through which it passes. This plant is one of the first in the U.K. to use dissolved air flotation. Treatment stages prior to this step are raw water screening, aeration, flash mixing (ferric sulfate, sodium hydroxide, chlorine, and activated carbon), flocculation, and potassium permanganate treatment. After the flotation step water is filtered through sand and chlorinated. Sludge is disposed of by lagooning. (Cassar-FRC)
W81-04276

5G. Water Quality Control

PRIME FARMLAND AND WATER QUALITY, Soil Conservation Service, Washington, DC.
K. K. Young.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche.

In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sep. 16-17, 1980, Chicago, IL. Environmental Protection Agency Report EPA-905/9-80-009, Sep. 1980, p 195, 3 Ref.

Descriptors: *Cropland, *Water pollution sources, *Soil erosion, *Farms, *Water quality, Sediments, Stream pollution, Soil conservation, Agricultural chemicals, Crop yield, Environmental control.

Food production involves a trade-off with water quality. Whenever the protective cover of vegetation is disturbed and the soil is tilled, the potential for erosion is increased. Increased erosion not only lowers productivity but increases sediment in streams and lowers water quality. Prime farmland is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment. There are about 346 million acres of prime farmland in the United States excluding Alaska, and 230 million acres were used for cultivated crops in 1977. From 1967 to 1975, about 8 million acres of prime farmland were lost to other uses. The loss of prime farmland to other uses means that more pressure is placed on nonprime lands to meet production demands. On a per-acre basis, the nonprime farmlands soils furnish the greatest amount of sediment and chemicals to streams. Environmental policy provides emphasis on preservation and conservation of prime farmlands. Much remains to be done to preserve the best cropland from irreversible conversions, protect productivity from erosion, and minimize damage to the environment. (Moore-SRC)
W81-03962

WATER QUALITY MANAGEMENT PLANS, STATUS, QUALITY, INTEGRATION AND IMPLEMENTATION, Environmental Protection Agency, Chicago, IL, Region V.
W. G. Benjey.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sep. 16-17, 1980, Chicago, IL. EPA Report EPA-905/9-80-009, September, 1980, p 47-51.

Descriptors: *Water quality management, *Nonpoint pollution sources, *Water pollution sources, Nonstructural alternatives, Geography, Interagency cooperation, Cost sharing, Regulations, Information exchange, Water pollution control.

The degree of specificity of Water Quality Management (WQM) plans in identifying and addressing water quality problems is highly variable. In general, point source problems are usually known and addressed with NPDES permits or section 201 municipal construction grants programs, while most of the nonpoint problems are known only in gross terms. A coordinated and integrated approach to point source and nonpoint source related aspects of pollution problems in specific areas is one of the primary features missing from current WQM plans. The lack of coordinated approaches can be remedied by taking all present pollution sources into account when devising geographic priorities for future study and implementation. It is inefficient to attempt to implement structural or nonstructural abatement methods across the countryside regardless of the variable locations and magnitudes of the problems. Five complementary approaches to water quality abatement are: following integrated sub-basin priorities; interagency cooperation; costsharing; regulation; and provision of more direct information and assistance to specific implementing agencies. (Moore-SRC)
W81-03965

LAND TREATMENT OF MUNICIPAL WASTEWATER, Idaho Univ., Moscow.
A. T. Wallace.

Available from the National Technical Information

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Sources vs. Diffuse Source Pollution, Sep 16-17, 80, Chicago, IL. EPA Report EPA-905/9-80-009, September, 1980. p 77-80, 11 Ref.

Descriptors: *Municipal waste water, *Land disposal, *Cost analysis, *Water quality management, Legislation, Design criteria, Waste water disposal, Groundwater pollution, Pollution load, Pollutants.

Land treatment systems can, under certain circumstances, yield substantial water quality benefits with low capital expense and low operating, maintenance and energy commitments. The systems are to be given serious consideration when the Clean Water Act is complied with, and Congress wrote into the Act a number of financial incentives to encourage their use. The design of land treatment systems proceeds by attempting to identify the land limiting constituent, which may include the liquid load, then better than minimal management of all other contaminants is automatically assured. The dilution and dispersion mechanisms are ineffective compared with conventional systems, so that once polluted, groundwater tends to remain so for a long time. Land treatment systems can be designed for flows closer to average daily flow without consideration of a peaking factor, can be expanded much more readily than conventional systems, and do not necessarily impose any significant aesthetic change on the receiving location. Regardless of the source and type of waste water and the type of soil or site conditions, there is probably some safe loading which will control all contaminants and still not degrade the terrestrial receiver to the extent that any future uses are irrevocably precluded, and in most cases the loadings are high enough to be economical. (Brambley-SRC) W81-03970

WATERSHED; A MANAGEMENT TECHNIQUE FOR CHOOSING AMONG POINT AND NONPOINT CONTROL STRATEGIES; PART 1- THEORY AND PROCESS FRAMEWORK.

Great Lakes Basin Commission, Ann Arbor, MI. W. C. Sonzogni, T. J. Monteith, T. M. Heidtke, and R. A. C. Sullivan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sep. 16-17, 80, Chicago, IL. EPA Report EPA-905/9-80-009, Sept., 80. p 87-124, 2 Fig, 7 Tab, 47 Ref.

Descriptors: *Water quality management, *Water pollution control, *Evaluation, *Nonpoint pollution sources, *Water pollution sources, Pollution load, Erosion, Cost-benefit analysis, Watersheds, River systems, Industrial wastes, Municipal wastes, Mass transfer.

To assist water quality managers and planners in formulating cost-effective pollution control strategies, a methodology was developed for evaluating alternative point and nonpoint source control within a drainage area. The methodology - referred to as WATERSHED - allows the user to estimate loadings from each major pollutant source and to examine load reductions and costs associated with control options. Point and nonpoint source control strategies can then be ranked on the basis of cost per unit reduction in pollutant loading to the receiving water. From this ranking, an optimum mix of programs can be identified which will achieve a required load reduction at least cost. Strategies can be staged, that is, they may consist of several levels of control. In evaluating loadings and control programs for a given drainage area, WATERSHED considers the hydrologic, physiographic and demographic characteristics of the basin, pollutant losses or entrapment during transport from source to river mouth, as well as the bioavailability of the pollutant under study. The approach is flexible and able to accommodate a variety of techniques for estimating loadings from municipal and industrial point sources and land

runoff. Although WATERSHED is primarily a data integration and accounting system, some methods for estimating loads are specifically addressed. Calculating cropland loads based on potential gross erosion determined from the Universal Soil Loss Equation (USLE) was found to be particularly useful, since the effect of control programs can be evaluated based on changes in the factors governing the USLE. (Brambley-SRC) W81-03970

WATERSHED; A MANAGEMENT TECHNIQUE FOR CHOOSING AMONG POINT AND NONPOINT CONTROL STRATEGIES; PART 2 - A RIVER BASIN CASE STUDY, Great Lakes Basin Commission, Ann Arbor, MI. T. J. Monteith, W. C. Sonzogni, T. M. Heidtke, and R. A. C. Sullivan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sep 16-17, 1980, Chicago, IL. EPA Report EPA-905/9-80-009, Sep 1980. p 129-161, 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Water quality management, *Water pollution control, *Evaluation, *Phosphorus removal, *Cost-benefit analysis, Pollution load, Non-point pollution sources, River systems, Priorities, Watersheds, Sandusky River basin, Ohio.

The WATERSHED management technique has been designed to help water quality managers select the most cost-effective pollution control program for a drainage area. WATERSHED has been applied to the Sandusky River Basin in northern Ohio to demonstrate how it is used and how to interpret the results. Programs to control total phosphorus loadings from point and nonpoint sources are evaluated using eight worksheets to compile the river basin data and carry out calculations. WATERSHED is applied in this manner: the river basin physical layout is conceptualized and all major total phosphorus sources are identified. Phosphorus loads from point sources, urban runoff, rural non-cropland runoff and cropland runoff are calculated for initial conditions and under different stages of control. Program costs are calculated and used to estimate the cost-effectiveness of each program. The forty programs identified are then prioritized according to their cost-effectiveness in reducing the total phosphorus load at the river mouth or receiving water. In this study, selection and implementation of programs 1-17 would reduce the phosphorus load by 240,000 kg/yr at a cost of \$600,000 per year. Addition of program 18 would effect a further reduction of 18,800 kg/yr but at an additional cost of \$1.6 million, this being the point where unit reduction costs begin to rise sharply. (Brambley-SRC) W81-03971

BMP CAUSE AND EFFECT RELATIONSHIPS BY SIMULATION.

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.

L. F. Huggins, D. B. Beasley, and E. J. Monke. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, Sep 16-17, 1980, Chicago, IL. EPA Report EPA-905/9-80-009, Sep 1980. p. 163-174, 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Nonpoint pollution sources, *Monitoring, *Simulation, *Model studies, *Water quality control, Agricultural runoff, Sediment transport, Nutrients, Small watersheds, Cost-benefit analysis, Water pollution control, Indiana.

The effectiveness and cost efficiency of efforts to control nonpoint pollution sources are difficult to determine. The two approaches available for making these determinations are field monitoring studies and simulation modeling. The two approaches are complementary. Models of single events can be transformed into average patterns,

while accurate models can only be based on long-term comprehensive monitoring. ANSWERS is a simulation model, designed for application to non-irrigated, row-crop agriculture which simulates the production and transport of water, sediment, nutrients and some chemicals in watersheds up to 15,000 ha. It was used as a tool for planning Best Management Practices (BMP) in two watersheds in Indiana. In one watershed ANSWERS was used to quantify BMP impacts and rank site specific BMP's and in the second it was used to yield a quantitative estimate of BMP benefits, using information from a monitoring program. (Brambley-SRC) W81-03972

PRACTICAL USES OF THE ANSWERS MODEL IN BMP PLANNING: AN ALLEN COUNTY EXPERIENCE.

Soil Conservation Service, Fort Wayne, IN.

D. McCain.

Available from National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, IL. EPA Report EPA-905/9-80-009, Sep., 1980. p 177-182, 1 Fig, 1 Tab.

Descriptors: *Computer models, *Model studies, *Water quality control, *Soil erosion, *Agricultural runoff, Small watersheds, Maps, Sediment yield, Land management, Soil conservation, Planning, Allen County, Indiana.

The ANSWERS model was used to identify and rank 13 small watersheds in Allen County, Indiana, according to gross soil loss per acre. Work is under way in six of the 13 watersheds to improve water quality. Computer drawn maps are used to present information to farmers, identifying critical erosion areas on individual farms. The sediment yields computed by the model represent a net loss of topsoil from the watershed. To reduce erosion farmers are encouraged to change tillage and planting techniques, to rotate crops, or introduce permanent land treatment practices such as terraces. Stream-bank erosion is highly visible to farmers, but contributes less to the total sediment load than sheet and rill erosion on sloping cropland. The Soil Conservation Service and the Agricultural Stabilization and Conservation Service can provide farmers with cost sharing and technical help to make a properly functioning project. A hypothetical watershed and reduction estimates are used to illustrate the use of the ANSWERS model in planning. (Brambley-SRC) W81-03973

WATER QUALITY: SEDIMENT AND NUTRIENT LOADINGS FROM CROPLAND.

Purdue Univ., Lafayette, IN.

D. W. Nelson, D. B. Beasley, S. Amin, and E. J. Monke.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, IL. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 183-201, 7 Fig, 7 Tab, 13 Ref.

Descriptors: *Water quality, *Agricultural runoff, *Soil conservation, *Sediments, *Nutrients, Water pollution sources, Agricultural watersheds, Nitrogen, Phosphorus, Pesticides, Farm management, Indiana.

The 5000 ha Black Creek watershed was selected for study to determine if water quality in the watershed and in the Maumee River could be improved by implementation of a wide range of soil conservation practices in the drainage area. Grab sampling stations were established at 14 sites within the watershed and on the Maumee River to provide weekly data on the quality of water originating from soils and land uses in the drainage area. Reconnaissance sampling within the watershed revealed that no significant amounts of

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Quality Control—Group 5G

hexane-soluble pesticides were present in water, sediment, or fish tissue. Data suggest that adoption of best management practices to control soil erosion has not resulted in a reduction in the discharge of soluble forms of N and P from the watershed. Best management practices implemented in the watershed during 1975 and 1976 resulted in reduced sediment losses in subsequent years, and were partly responsible for reductions in amounts of sediment-bound nutrients. There is little sediment deposition in small watersheds, but considerable deposition in the Black Creek area. Findings suggest that monthly or annual loadings of nitrate and ammonia nitrogen, soluble organic N, soluble inorganic P, and soluble organic P leaving a watershed can be approximated by multiplying the annual flow weighted mean concentrations by the volume of runoff during the period. Monthly or annual loadings of sediment-bound N and P leaving a watershed can be estimated by multiplying the mean total N and P concentrations in sediment by the amount of sediment discharged. (Moore-SRC) W81-03974

BIOLOGICAL MONITORING METHODOLOGIES FOR OIL SHALE AREA SURFACE WATERS WITH EMPHASIS ON MACROINVERTEBRATE SAMPLING TECHNIQUES.
Environmental Monitoring Systems Lab., Las Vegas, NV.

For primary bibliographic entry see Field 7B.

W81-03997

REVIEW OF ALTERNATIVES FOR EVALUATION OF SEWER FLUSHING; DORCHESTER AREA — BOSTON,
Bogert (Clinton) Associates, Fort Lee, NJ.
For primary bibliographic entry see Field 5D.

W81-04014

PRESERVATION OF AQUEOUS SYSTEMS WITH ALPHA-CHLORO-BETA-AMINOCROTAMIDE.
Givaudan Corp., Clifton, NJ. (Assignee); and Hoffmann-La Roche, Inc., Nutley, NJ. (Assignee).
For primary bibliographic entry see Field 5F.
W81-04081

CORROSION INHIBITING COMPOSITIONS,
Mogul Corp., Chagrin Falls, OH. (Assignee).
R. J. Lipinski.
U.S. Patent No. 4,217,216, 5 p, 4 Tab, 11 Fef;
Official Gazette of the United States Patent Office, Vol 992, No 2, p 612-613, August 12, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, Corrosion, Inhibition, Scaling, Industrial water, Chemical reactions, *Corrosion control.

It has been found that hexamethylenediamine tetra(methylene phosphonic acid) and the dimer including various derivatives of the acid and its dimer when used in effective amounts are capable of protecting metals and alloys, e.g. copper, brass, steel, etc. The corrosion inhibiting composition may be used in various aqueous systems including, for example, air conditioners, steam generating plants, refrigeration systems, heat-exchange pipes and related equipment. A process is provided for inhibiting the corrosion and tarnishing of metals and particularly metal containing copper and iron by utilizing small, but effective amounts of an aminomethylene phosphonic acid and its derivatives in combination with a molybdate, e.g. sodium molybdate. (Sinha-OEIS) W81-04085

METHOD AND APPARATUS FOR PURGING DISINFECTING HIGH PURITY WATER DISTRIBUTION SYSTEMS,
D. W. Hopkins.
U.S. Patent No 4,216,185, 9 p, 3 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 244, August 5, 1980.

Descriptors: *Patents, *Water quality control, *Water treatment, Disinfection, Water distribution,

Bacteria, Piping system(Mechanical), Water reuse, Purging, Ultrapure water systems.

High purity water distribution system are purged and disinfected by incorporating an outlet purge line into the conventional recirculating loop of the prior art. The purge line communicates with each outlet opening of the water system and allows systematic sequential purging at preset intervals of the branch lines and outlets in the system. The invention also includes means for disinfecting the water on a different cycle than the intermittent purging of the branch lines and outlets. Purging of branch lines and outlets may occur every hour and periodic disinfection as by chemical injection of disinfectants as ozone every 24 hours. The purge line may return the effluent to a reservoir for further treatment. (Sinha-OEIS)
W81-04096

WATER AERATOR,

P. J. Mineau.

U.S. Patent No 4,216,091, 7 p, 5 Fig, 12 Ref; Official Gazette of the United States Patent Office, Vol 997, No 1, p 220, August 5, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, *Aeration, Equipment, Bodies of water, Lakes, Pumps.

An aerator is provided for efficiently aerating bodies of water in the summer or winter by providing aerated water near the bottom of the lake body. The aerator comprises a housing with sides, a bottom and a concave top wall. At least a portion of the housing has an annular core of buoyant material for supporting the aerator. The top wall of the housing slopes downwardly to a central opening at which a central conduit extends downwardly through the central portion of the housing and below it. Aerator pumps are spaced about and a distance from the central opening in the top wall; each having means to draw water from beneath the annular core and spray the water through the air above the top wall so that it is deposited on the top wall and flows to the central opening. Means are provided for driving the water downwardly through the conduit to disperse the aerated water below the housing. One aspect of the invention provides legs to be secured to the housing so that the housing can be supported by the legs on the bottom of the lake. (Sinha-OEIS)
W81-04119

YOUR STORAGE PROBLEM'S SILVER LINING COULD BE MADE OF FLEXIBLE PVC,
Water and Pollution Control, Vol 119, No 1, p 16, January, 1981.

Descriptors: *Linings, Hydraulic engineering, Materials engineering, Plastics, Polymers, Storage tanks, Structural engineering, Water treatment materials, Caustic soda, Liquid alum, Hydrofluosilicic acid, Water pollution control.

Kentain Products Ltd. of Kitchener, Ontario, makes flexible liners for use in many severe environments. Many of the Kentain liners can be installed by the customers' own maintenance crews, and they provide additional savings in reduced down time. The liners can be custom fitted to any shape or size and are used municipally in storage tanks for caustic soda, liquid alum, hydrofluosilicic acid and sodium hypochlorite. The Regional Municipality of Durham, Harmony Creek Water Pollution Control Plant in Oshawa, Ontario, has installed a Kentain polyvinyl chloride flexible liner to reline a tank used for storing liquid alum at a maximum temperature of 160 F. The liner was installed in 3 days in one piece and required very little tank preparation. Two Kentain lagoon liners were installed by the District Municipality of Muskoka in Port Carling, Ontario, in 1979 and 1980, taking only one day to install each liner. The chlorinated polyethylene liners provided a 50% savings in installation time due to their ease of handling. (Geiger-FRC)
W81-04118

FLEXIBLE MEMBRANE LININGS PROVIDE AN ENGINEERING SOLUTION,
G. Salberg.

Water and Pollution Control, Vol 119, No 1, p 14, 29, January, 1981.

Descriptors: *Linings, *Materials engineering, Hydraulic engineering, Environmental sanitation, Structural engineering, *Water storage, Water management, *Water pollution prevention, Membranes.

Flexible membrane linings have come of age as an engineering tool for the containment and/or covering of liquids in such diverse applications as water storage reservoirs, tailings dams, oil spill containment and brine storage. Many prestigious groups, including the US Environmental Protection Agency, have approved the use of membrane linings in pollution control and water management. Standards are being prepared for flexible membrane lining systems to be used under different conditions and temperatures. The major sectors of suppliers in the flexible membrane lining industry are the raw material producers, the professional firms in the rubber and plastics technology business, and the applied engineering companies. The use of linings has expanded from the areas of low cost earth water reservoirs, canals, and sewage lagoons to the fields of hydrocarbon and hazardous materials spill containment. Flexible membrane linings are also being used for the collection of acid mine and sanitary landfill leachates. Flexible membranes are being utilized as floating covers for water reservoirs and various types of pollution control systems. The success of flexible membrane linings is attributed to the close liaison between the designers and applied engineering firms which produce the liners. Research is being conducted to test the performance of flexible membrane linings under a variety of environmental conditions. (Geiger-FRC)
W81-04119

MANAGEMENT CONTROL PLAN FOR PROTECTING GROUND-WATER QUALITY,

H. E LeGrand.

Ground Water, Vol 18, No 1, p 2-6, January/February, 1980.

Descriptors: *Groundwater management, *Water quality management, Water quality control, Groundwater pollution, Surface-groundwater relations.

This discussion is designed to show that regulations can only be a preamble to a management control system, which is not in existence as yet, to control the several problems facing the environment from different sources of pollution. Two major problems of contamination are cited: first, the widespread contamination of aquifers, and second, the contamination of surface water bodies from slow flowing contaminated underground water to streams and lakes. A good management method to control the overall problem is needed, rather than facing each individual case of pollution as it arises. Some newly drafted Federal and State regulations may aid in the solution. Among these is the Resource Conservation and Recovery Act, which is directed toward the protection of groundwater resources. A difficult aspect of the problem has been the polarized concepts of four major groups which must be involved in the solution: officials of regulatory agencies, geologists and hydrologists, design engineers, and owners and operators of water management facilities. Reconciling the differences in concepts among these four groups is more important at this point than a mere promulgation of regulations. A standardized system of description and evaluation is badly needed to allow recording of concise, pertinent information. (Baker-FRC)
W81-04138

TOXICS—TRUTH AND CONSEQUENCES,

D. V. Feliciano.

Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1857-1864, July, 1980.

Descriptors: *Toxicity, *Water quality, *Water pollution control, Carcinogens, Reviews, Public

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

health, Risks, Organic compounds, Inorganic compounds, Waste dumps, Leaching.

An overview of the problems posed by toxic chemicals in the environment is presented. Under the Clean Water Act of 1977, 129 priority pollutants have been identified for which effluent limitations based on best available technology treatment requirements were to be established by December 31, 1979, and implemented by June 1, 1983. Although blocking the entry of a toxic substance into water does not necessarily block its entry into the environment, water is a major vehicle for transporting such materials. Criteria for identifying the priority pollutants selected by the Environmental Protection Agency are summarized. Data on the extent of the priority pollutants in waste water entering publicly owned treatment works will be used to develop strategies for attaining the 1983 goals. The problem of toxic materials is complicated by chemical changes which occur after they have entered the environment. A variety of factors influence the ability of a toxic substance to elicit a harmful effect and the degree of that effect in species and in individuals. Safety factors and threshold doses have been developed for many chemicals whose toxic effects are reversible and nonprogressive, but the application of this approach to pollutants that cause chronic, irreversible, and progressive disease in laboratory animals is controversial. In spite of the many problems, animal testing for possible toxic effects provides the closest approximation and evaluation of potential effects on humans. Although many carcinogens have been identified, the role of specific toxic chemicals in cancer rates is unknown. While controlling sources of toxic chemicals in effluents, sludges, and drinking water is necessary in the short run, in the long nontoxic substitutes should be found for the toxic chemical wastes now produced. (Carroll-FRC)

W81-04179

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ECONOMIC MODEL FOR RESERVOIR PLANNING,

Rand Corp., Santa Monica, CA.
N. Y. Moore, and W. W-G. Yeh.

Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR2, p 383-400, July, 1980, 3 Fig, 4 Tab, 39 Ref. OWRT-C-5184(No 4208)(6).

Descriptors: *Planning, Reservoir construction, *Model studies, *Cost-benefit analysis, Eel River, California, Construction, Mathematical models, Prices, Economics, Project planning, *Water supply development, Reservoir.

A dynamic programming model to aid in efficiently planning water supply capacity expansion through reservoir construction is presented. This model differs from previous ones as follows: by calculating benefits using willingness-to-pay criteria, by maximizing benefits rather than minimizing costs, by considering the interdependent nature of reservoirs, and by allowing price to ration water as an alternative to construction. The Eel River, California, projects an interconnected 6-reservoir system, was used to demonstrate the workability of the model. (Cassar-FRC)

W81-03960

A CONCEPTUAL MODEL FOR AN INTEGRATED ENVIRONMENTAL ANALYSIS ON OIL SHALE TRACT C-B,

Bureau of Land Management, Fort Collins, CO, Office of Planning, Inventory, and Environmental Coordination.

For primary bibliographic entry see Field 5C.
W81-03988

GROUNDWATER QUALITY SAMPLING APPROACHES FOR MONITORING OIL SHALE DEVELOPMENT, General Electric Co., Santa Barbara, CA. Center for Advanced Studies.

For primary bibliographic entry see Field 5C.
W81-03989

SIMULATING SEAWATER INTRUSION, D. Stephenson.
Nuclear Active (Pretoria), No 22, p 14-16, 1980. 5 Fig, 1 Ref.

Descriptors: *Saline water intrusion, *Water table, *Drawdown, *Nuclear powerplants, *Mathematical models, Groundwater movement, *Koeberg, South Africa, Aquifer characteristics, Interfaces, Simulation, Simulation analysis, Mathematical studies, Concrete construction, Earthquake engineering, Baseline studies, Design criteria, Construction.

A mathematical model was used to simulate the intrusion of seawater that would be caused by the drawdown in the water table during the construction of the Koeberg nuclear power station. Special structural designs were needed due to the location of the station within 200 m of the original shoreline and due to the unusually high earthquake acceleration of the area. To construct the needed foundations, the site was to be excavated down to bedrock, a bentonite-cement wall sunk and the area dewatered. The proposed drawdown of the water table could cause seawater intrusion into the foundation area resulting in chemical attack on the foundations. Prior to construction a computerized mathematical model predicted the extent of seawater intrusion by modelling the groundwater flow of the site. To develop the model, the site was overlain by an imaginary square mesh grid and equations for water flow and drawdown were established for each point of the grid. These aquifer equations were solved by replacing the differentials by finite differences and solving them explicitly. Small time steps were used to ensure stability. Model results were verified by water levels and by borehole results. The model was able to simulate the entire dewatering process rapidly so that remedial steps could be tried long before the actual condition arose on site. (Seigler-IPA)

W81-04051

METAGAME ANALYSIS OF THE GARRISON CONFLICT,

Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
K. W. Hipel, and N. M. Fraser.
Water Resources Research, Vol 16, No 4, p 627-637, August, 1980, 11 Fig, 2 Tab, 15 Ref.

Descriptors: *Decision making, *Legal aspects, *Political aspects, *Water rights, Garrison Diversion, Game theory, Irrigation, International law, Systems engineering.

Metagame analysis, a game theory which can be used to analyze options in real-world political problems, has been used to assess the political feasibility of a water resource project. The Garrison Diversion Unit is a partially constructed multi-purpose water resource project involving transfer of water from the Missouri River Basin to areas of North Dakota in the Hudson Bay Basin. Although U.S. residents can expect major benefits, Canadians and some U.S. environmentalists fear environmental damage. Metagame analysis predicts possible feasible political solutions to the conflict as well as possible future developments. If the conflict retains the format as analyzed, it is expected that Canada will pursue legal action based on the Boundary Treaty. (Cassar-FRC)

W81-04109

HARD OR SOFT ENVIRONMENTAL SYSTEMS.

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
M. B. Beck.
Ecological Modelling, Vol 11, No 4, p 233-251, February, 1981, 2 Fig, 26 Ref.

Descriptors: *Systems analysis, *Water quality, *Model studies, Calibrations, Forecasting, Mathematical models, Environmental effects, Lakes, Streams.

This paper discusses the state of environmental modeling and the conflict between increasing model size and complexity to increase accuracy vs. model simplification to improve applicability. In 'hard' systems model behavior can be confirmed with experiments; in 'soft' systems, such as socio-economic analysis, the results are strongly colored by the analyst's opinions. Water quality models are described as lying between the 2 extremes. Two schools of thought may develop with respect to water quality models. The proponents of the 'hard' systems are challenged to construct a meaningful picture of the fabric of water quality-ecological systems. The 'soft' system thinkers are encouraged to predict only to the degree that uncertainties in calibration and the model allow. This paper argues that there is an intimate relationship between prediction and model calibration. This relationship is especially important in accounting for uncertainty in the development and use of models. (Cassar-FRC)

W81-04123

INTEGRATING COASTAL ZONE AND ELECTRIC FACILITY PLANNING: WEAK LINKS IN THE INSTITUTIONAL CHAIN,

Clark Univ., Worcester, MA.
D. W. Dusik.
Coastal Zone Management Journal, Vol 8, No 4, p 263-288, 1980. 46 Ref.

Descriptors: *Coastal zone management, *Powerplants, *Site selection, Environmental effects, Planning, Regulations, Water pollution prevention, Water quality, Coasts.

Direct interaction between coastal planners and electric companies is necessary to successfully plan for future energy-related development along the coast. Regulation of power plant siting is complicated and in many states is diffused across more than a score of separate agencies. The National Oceanic and Atmospheric Administration's Office of Coastal Zone Management (CZM) requires that states adopt a procedure which identifies likely facilities in a timely manner and determines whether they may significantly affect the coastal zone. A procedure must also be established to determine the relative merits of alternative sites. Those responsible for the state CZM program should also be involved in the licensing aspect. There must be a link between government regulation of siting and the planning of utility companies. Important coastal considerations may not be sufficiently taken into account by utility planners, and state and federal licensing authorities are not in any position to ensure that tradeoffs made throughout the siting process are consistent with public as opposed to purely private interests. Coastal zone management agencies are advised to strengthen their interface with utilities and not to limit their attention to problems of interagency coordination. (Small-FRC)

W81-04142

MINICOMPUTER, MICROPROCESSOR AND TELECONTROL APPLICATIONS TO A WATER SUPPLY NETWORK,

East Worcestershire Water Co. (England).
K. C. Marlow, and F. Fallside.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 6, p 517-545, November, 1980, 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Computers, *Water supply, *Network design, Data processing, Automation, Data storage and retrieval, Computer programs, Planning, Economic costs, Water treatment, Data acquisition, Data collections, Maintenance, Monitoring, Operating policies, Administration, United Kingdom.

The East Worcestershire Waterworks Company's scheme for automating a water supply network is described, and problem areas, operational considerations, and future concepts are discussed. Four

Techniques Of Planning—Group 6A

possible approaches for plant operation are: fully manned, partially manned, and unmanned plants, and on-line computer control. The degree and sophistication of instrumentation required are inversely proportional to the level of station manning. The experience of East Worcester establishes the economic viability and reliability of the use of minicomputers and telecontrol. Successful application of minicomputers suggests that the use of a microprocessor in a similar role would be appropriate. These could reduce existing equipment costs and improve instrument reliability. (Titus-FRC)
W81-04165

TOTAL ENERGY CONCEPT AT THE JOINT WATER POLLUTION CONTROL PLANT,
Los Angeles County Sanitation Districts, Whittier, CA.

For primary bibliographic entry see Field 5D.
W81-04166

STOICHIOMETRY AND KINETICS OF BIOLOGICAL WASTE TREATMENT,

Notre Dame Univ., IN.
R. L. Irvine, J. E. Alleman, G. Miller, and R. W. Dennis.
Journal of the Water Pollution Control Federation, Vol 52, No 7, p 1997-2006, July, 1980. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Biological waste water treatment, *Mathematical models, *Chemical reactions, Model studies, Kinetics, Systems analysis, Nitrogen.

This paper presents a fundamental procedure for developing a reaction scheme (stoichiometry), handling kinetic expressions, and reducing the biological waste water treatment system to important reactions and kinetics. Emphasis is placed on developing a reaction scheme that both contains all important reactions for a given treatment situation and provides at least a qualitative understanding of the problem, rather than on accepting a scheme that generates a quantitative result even though critical information has been excluded. Incomplete knowledge may result in inadequate design and confused operation. The procedure developed for handling multiple-reaction systems is a powerful and concise way to translate technical insights generated from both continuous-flow and sequencing batch reactor systems for use in either system. Application of the procedure to the specific case of biological nitrogen removal shows that the reaction scheme developed from the sequencing batch reactor system helps to explain conflicting observation of nitrogen removal in continuous-flow systems and is directly applicable to the design and operation of both continuous-flow and batch reactor systems. (Carroll-FRC)
W81-04167

MONITORING, MANAGEMENT AND CONTROL OF IRRIGATION PROJECTS: THE EXAMPLE OF MWEA, KENYA,
Wye Coll., Ashford (England).

E. Clayton.
Water Supply and Management, Vol 5, No 1, p 107-115, 1981. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Irrigation, *Planning, Water supply, Water distribution, *Kenya, Management planning, Long-term planning, Project planning, Water management.

The major aim of a project management and control system is to make actual equal predicted performance. Management must strive to meet the established project objectives as long as they continue to be viewed as valid. Project control embraces technical personnel, auditing and budgeting control. The functions of project control and management are often linked, as there is much overlap between them. Control and management depend not only on a staffing structure appropriate to the type and size of the project, but also on the quality of the staff at all levels of management. The shortage of highly qualified personnel is particularly severe in rural sectors and on agricultural projects.

Wages and salaries are frequently unattractive. Project monitoring involves measuring and recording system activities in an ongoing manner so that proper data can be supplied to the management and control persons. Project monitoring must not only include the technical aspects of the system, but should also include monitoring personnel performance. The monitoring of the project at Mwea, Kenya, is used as an example of management and control in an on-going situation. (Baker-FRC)
W81-04258

THE INFORMATION PROBLEM OF SOUTH INDIAN IRRIGATION CANALS,
Sussex Univ., Brighton (England).

R. Wade.
Water Supply and Management, Vol 5, No 1, p 31-51, 1981. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Irrigation, *Planning, Water management, Management planning, *India, Long-term planning, Project planning, Water supply, Water distribution.

Problems confronting the operation of irrigation canals in low income countries are discussed. Two fundamental irrigation problems emerge. First, it is difficult to determine the amount of potential remaining to be developed. Very often the figures used to evaluate the irrigation program are not accurate. Often the national irrigation statistics are based on figures collected by an agency which also collects water rates but is not responsible for operating the systems. In order to bring the figures into an acceptable degree of accuracy, a major effort may be required. However, an even more significant problem is the lack of proper management over water control. Information feedback is often weak or blocked completely. Principles based on which water controllers make decision are rudimentary. The ability to enforce decisions is extremely limited within relatively large units of allocation, reflecting a lack of ability to control the supply. Personnel are frequently found to have responded to bribes for additional water, or to be lax on reducing waste. If progress is to be made, problems such as these must be addressed. (Baker-FRC)
W81-04259

NEGLECT OF O & M IN IRRIGATION. THE NEED FOR NEW SOURCES AND FORMS OF SUPPORT,
I. Carruthers.

Water Supply and Management, Vol 5, No 1, p 53-65, 1981. 2 Tab.

Descriptors: *Irrigation, *Planning, Water management, Management planning, Long-term planning, Project planning, Water distribution, Water supply, *Developing countries.

There is an acknowledged gap between the potential and the actual performance of development projects in general and of water irrigation projects in particular. The reasons for this gap are investigated, with emphasis on assisting project staff in the preparation of operation and maintenance projects of various types and in detailing the operational and maintenance aspects of new irrigation projects. Inadequacy in this area will have a direct impact on the productivity of agriculture, the cost of the irrigation agency, and there will be indirect effects on the whole of the community as well. While it is difficult to specifically diagnose deficiencies in the areas of operation and maintenance, guidelines for doing so are offered. Problems stemming from planning practices are also delineated. An example of 95 bottleneck codes used for reporting problems in Pakistan is provided. These bottlenecks arise in the areas pertaining to obtaining approval for the system, release of funds, use of staff resources, acquisition of land, designing and cost estimation, tender work, construction, machinery and other materials, natural calamities and miscellaneous. (Baker-FRC)
W81-04260

IMPROVING CANAL MANAGEMENT: THE ROLE OF EVALUATION AND ACTION RESEARCH,

A. Bottrall.

Water Supply and Management, Vol 5, No 1, p 67-79, 1981. 27 Ref.

Descriptors: *Irrigation, *Planning, *Water management, Management planning, Long-term planning, Project planning, Water distribution, Water supply, *Developing countries.

A major cause of poor performance in many of the large irrigation schemes in parts of the developing world has been deficient management. This is true particularly in the operation of main canal systems. Even though many of these governments have attempted to improve the situation, a steadfast reluctance has been apparent to acknowledge that poor main system water distribution is at the heart of most irrigation management problems. A four year comparative study has been made of the organization and management of large irrigation schemes financed by the World Bank. The evaluation calls for understanding the local in which the system is to be working, evaluating performance and potential, identifying the cause of performance deficiencies, and recommending remedial action. While specifics which need to be examined will vary from case to case, the following areas should be examined thoroughly: water distribution, main system maintenance, watercourse support services, and agricultural extension. Some of the most common and most important deficiencies are inefficient and inequitable water distribution, lack of formal representative farmer involvement, extremely inadequate resources of finance and personnel, inadequate funds for operation and maintenance, and the fact that decision making about irrigated agriculture is often dominated by an Irrigation Department with little communication to the Agricultural Department. (Baker-FRC)
W81-04262

HOW NOT TO LEARN FROM PILOT IRRIGATION PROJECTS: THE NIGERIAN EXPERIENCE,

Wye Coll., Ashford (England).

R. Palmer-Jones.

Water Supply and Management, Vol 5, No 1, p 81-105, 1981. 30 Ref.

Descriptors: *Irrigation, *Planning, Water management, Management planning, *Nigeria, Long-term planning, Project planning, Water distribution, Water supply, Irrigation design.

Experience with irrigation schemes in Nigeria is reviewed. This experience has demonstrated certain factors essential to the evolution of investment patterns and management policies. Early in the colonial period the Department of Agriculture in Nigeria undertook a pilot irrigation project at Kwarre, north of Sokoto. Although this system ceased operation in 1963, many valuable lessons were learned from it. At that time it was viewed as necessary that some form of coercion be employed to encourage the farmers to farm on the irrigated land. In 1928 the view was commonly held by the Irrigation Engineer that farmers were generally lazy. Rather than providing economic incentives for the farmers, economic penalties were imposed on those who were not willing to cultivate the land up to its potential. By the 1950's irrigation rules were promulgated by the Native Authorities. No provisions were made for farmers whose crops failed due to the failure of the water supply. Problems growing out of technical, agronomic, and economic considerations made it difficult to enforce any regulations. Basic defects in the general system design were also responsible for many of the problems. The arrangements by which water is drawn off, the alignment and grading of the main canal, and the internal distribution system could all have been vastly improved. Basic problems in water management and distribution also existed. (Baker-FRC)
W81-04263

THE SOCIOLOGY OF IRRIGATION MANAGEMENT IN SRI LANKA,

M. P. Moore.
Water Supply and Management, Vol 5, No 1, p 117-133, 1981. 18 Ref.

Field 6—WATER RESOURCES PLANNING

Group 6A—Techniques Of Planning

Descriptors: *Irrigation, *Planning, Water supply, Water distribution, Training, Management planning, Long-term planning, Project planning, Water management, *Sri Lanka, Social aspects, Asia.

This paper was designed to demonstrate that a relatively simple sociological analysis can be performed to provide some insight into the working of a branch of the public service an shed light on possible solutions so as to improve service therein. There is a great need in Sri Lanka to improve the water management program so as to increase the productivity of the Dry Zone in an agricultural sense. This requires improvement in the large scale irrigation schemes. One area of effort should be the building of a more responsible farmer's group in Sri Lanka, or several such groups. However, the major effort must come from the irrigation bureaucracy in reforming its practices. Political interference and inadequate maintenance budgets have hurt the process of the irrigation system in this area. More effective scheduling practices are needed along with the installation and use of water measuring devices, control devices and all outlets down to the level of the field channel, a program of rotation of deliveries at the level of main canals, distributaries and perhaps field channels, and a monitoring mechanism to report on the field situation. Effective sanctions must be made against cultivators who violate existing rules. It is extremely important that personnel placed at management levels be trained carefully and thoroughly in all factors involved in water management. (Baker-FRC)
W81-04264

6B. Evaluation Process

LAND TREATMENT OF MUNICIPAL WASTEWATER,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 5G.
W81-03968

COSTS FOR WASTEWATER TREATMENT,
Environmental Protection Agency, Chicago, IL, Region V.
For primary bibliographic entry see Field 5D.
W81-03969

BMP CAUSE AND EFFECT RELATIONSHIPS BY SIMULATION,
Purdue Univ., Lafayette, IN, Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W81-03972

FEASIBILITY STUDIES FOR SMALL SCALE HYDROPOWER ADDITIONS: A GUIDE MANUAL,
Hydrologic Engineering Center, Davis, CA.
Army Corps of Engineers Report, July, 1979. 321 p, 113 Fig, 42 Tab, 118 Ref.

Descriptors: *Feasibility studies, *Hydroelectric power, *Economic aspects, Hydrologic aspects, Safety, Impoundments, Financial feasibility, Hydroelectric plants, Damsites, Stability analysis, Cost-benefit analysis, Civil engineering.

This manual provides technical data and procedural guidance for the systematic appraisal of the viability of potential small hydropower additions. It focuses upon the concepts, technology, and economic and financial issues unique to small hydropower additions, and was developed for use by public agencies, public and private utilities, and private investors. A significant major positive feature of small hydropower additions is that many of the important environmental issues have been previously resolved, since the impoundment site exists and is presently in service. Physical facilities can be kept simple and functional, so that implementation will be possible in relatively short time frames. Small hydropower projects include installations that have 15,000 kilowatts or less capacity. The cost of fossil fuels is expected to continue to grow and thus increase the economic attractiveness of

small hydropower such that within the next 10 years, upwards of 2,000 sites may warrant serious study for implementation. A documented procedure is provided for performing a market analysis, the economic feasibility determination, and the financial feasibility determination. Procedures needed to determine the integrity of the existing structure during the passage of major flood events, and to determine the capacity and energy potential at the site are detailed. Another prerequisite to serious consideration of a site for a small hydro addition is that it be capable of meeting current dam safety standards. Procedures are given for selecting electromechanical and civil features suitable for small hydropower additions. (Moore-SRC)
W81-04018

THE ROLE OF WATER: ITS CONTRIBUTION TO RURAL DEVELOPMENT,
Water Development Corp., Salisbury (Zimbabwe). R. M. Wild.
The Zimbabwe Rhodesia Science News, Vol 14, No 1, p 15-17, January, 1980.

Descriptors: *Zimbabwe Rhodesia, *Rural development, *Rural areas, *Irrigation requirements, *Water requirements, Tribal lands, Tourism, Urban planning, Agricultural engineering, Dam construction, Developing countries, Future planning, Training, Decision making, Water conservation.

The Integrated Plan for Rural Development published by the Treasury of Zimbabwe Rhodesia in 1978, identifies eight objectives of rural development. Water will be the limiting factor in Zimbabwe Rhodesia's national development and, as such, it plays an important role in all the objectives of rural development. The physical resource development objective recognizes that large-scale irrigation offers the greatest scope for bringing more resources into production. The second objective, agricultural land settlement, requires the location of surface water, available underground water, or a supply from a large dam. The third objective, tribal trust land development, will require underground water from boreholes and wells and protection and improvement of existing catchments and waterways. Urban development in tribal trust lands will depend on the development of a reliable water supply capable of future expansion at a reasonable cost. Growth and stability of commercial agriculture is almost totally dependent on well managed irrigation. Urban development in existing centers and the development of tourism are both tied to water supplies and both will aid in rural development. The eighth objective is to provide adequate training and motivation for irrigators. (Seigler-IPA)
W81-04037

S.O.S. FOR MOUNTAIN CATCHMENTS,
Forestry Research Inst., Pretoria (South Africa). F. J. Kruger, D. W. van der Zel, and R. H. Andrag.
Ekos (Pretoria), Vol 1, No 1, p 18-21 and 23-25, 1980. 11 Fig, 2 Tab.

Descriptors: *South Africa, *Mountain catchments, *Watershed management, *Afforestation, Forest watersheds, Runoff volume, Land use, Future planning, Management planning, Forestry, Protection, Mathematical models, Permits, Legislation, Law enforcement.

In 1970 the Government of South Africa entrusted the Department of Forestry with the necessary statutory powers to manage mountain catchments through the enactment of the Mountain Catchment Areas Act. South Africa's mountain catchments occupy about 8% of the land surface but yield 49% of the country's total annual runoff. The economic importance of a catchment's surface water resources is used to establish an order of priority among Mountain Catchment Areas. Afforestation is limited in the catchment areas based on the calculated effect of timer plantations on runoff in relation to downstream water demand. An afforestation permit system recognizes three categories of catchments: category 1, where no afforestation

is permitted because water resources are already full committed; category 2, where limited afforestation is permitted because future water shortages are anticipated; and category 3, where afforestation is allowed to the extent of causing a 10% runoff reduction. To aid in management decision making, the Jonkershoek hydrological research complex maintains an outstanding research program on the problems of catchment conservation covering the areas of catchment hydrology, the ecology of mountain lands, and research on recreational use. Extensive planning, management, and monitoring are used to protect South Africa's mountain catchments. (Seigler-IPA)
W81-04039

TROUT ON THE FARM,
S. J. McVeigh.
Farmer's Weekly (Mombeni Natal), p 78-80, March 26, 1980. 6 Fig.

Descriptors: *Trout, *Farm ponds, *South Africa, *Fish stocking, Fish ponds, Fish physiology, Fish establishment, Fish eggs, Spawning, Bass, Water temperature, Dissolved oxygen, Life cycles, Aquaculture, Aquatic habitats.

The rainbow trout and some of the other trouts have adapted well to the warm conditions of South Africa, however, most farm dams are not suitable for keeping trout and farmers should carefully consider the required habitat factors before stocking a dam with trout. Trout require the cleanest and clearest conditions to survive. They are primarily coldwater fish and their natural habitat is in cold, fast running streams and rivers. Spawning takes place in winter at water temperatures of about 4 to 8 C. Many South African rivers do not have suitable spawning conditions, but they can be stocked from hatcheries. If water temperatures are too high, the oxygen content of the water will be too low for trout. The optimum water temperature for trout is about 16 to 18C, beyond 21C oxygen transfer becomes increasingly difficult for trout. Excessive acidity or alkalinity can also be a limiting factor for trout. Trout, like salmon, can withstand the changes in salinity from freshwater to total seawater and back again. If a farm owner's conditions are not ideal for trout, he should consider some other fish species such as bass or bream. (Seigler-IPA)
W81-04045

AN ECONOMIC ANALYSIS OF WETLAND PROTECTION,
Tufts Univ., Medford, MA. F. R. Thibodeau.
Journal of Environmental Management, Vol 12, No 1, p 19-30, January, 1981. 5 Tab, 33 Ref.

Descriptors: *Wetlands, *Cost-benefit analysis, *Compensation, Property values, Water resources, Economics, Charles River, Boston, *Massachusetts, Legal aspects, Compensation values, Cities, Adjacent land owners, Eminent domain, Water law, Nutrients, Recreation, Groundwater availability, Land appraisals, Land reclamation, Evaluation, *Wetland protection.

The economic value of wetlands in the Charles River Basin, Boston, Massachusetts, was estimated at \$153,535 to \$190,009 per acre, the water supply value accounting for \$100,730 of the total. Other factors used in the cost-benefit analysis were increases in land value from flood prevention and increased privacy for abutting land owners, pollution reduction potential (nutrients, BOD, and toxic substances), recreation and esthetics, scientific and special cultural interest, vicarious consumption, and undiscovered benefits. Benefit-cost ratio, using a \$1,000 per acre average market value and a conservative \$150,000 per acre benefit value, is 150:1. Economic analysis can be used to determine compensation, if any, that should be paid to wetlands property owners prevented from developing their sites by regulations and preservation policies. (Cassar-FRC)
W81-04161

THE DESIGN AND CONSTRUCTION OF BAKETHIN DAM, KIELDER WATER SCHEME,

Water Demand—Group 6D

Babtie, Shaw and Morton, Glasgow (Scotland). For primary bibliographic entry see Field 8A. W81-04270

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER QUALITY MANAGEMENT PLANS, STATUS, QUALITY, INTEGRATION AND IMPLEMENTATION, Environmental Protection Agency, Chicago, IL. Region V. For primary bibliographic entry see Field 5G. W81-03965

NEW CONCEPTS IN WATER METERING COSTS,

R. M. Burle. Municipal Engineer (Johannesburg), Vol 11, No 1, p 19, January/February, 1980.

Descriptors: *Multijet Fanwheel Meters, *Water metering, *Cost analysis, *Decision making, South Africa, Maintenance, Maintenance costs, Economic aspects, Water costs, User charges, Utilities.

In selecting a water meter, three factors must be considered: (1) purchase cost of the meter, (2) cost of repair during service life, and (3) the effective service life. The cost of metering is inversely proportional to the service life of the meter so that the selection of a water meter on the sole merit of a lower purchase price is not always justified. A 50% increase in service life can halve the cost of metering assuming other factors are equal. The harsh conditions placed on a meter in South Africa such as high TDS content, sand and grit, and excessive short-peak flow-rates, favor meters of the velocity type. Although expensive, Multijet Fanwheel Meters offer extended service life which can more than offset their purchase price. These meters also offer low cost of repair since they can be recalibrated at the external calibration screw. The relatively low cost cartridge in these meters can be replaced in the field without removal of the meter. The use of these meters in Hamburg, Germany, was justified without even mentioning their purchase prices. (Seigler-IPA) W81-04044

TRY CAPACITY CHARGES TO GENERATE WATER UTILITY CAPITAL,

T. Catlin. American City and County, Vol 96, No 2, p 61-63, February, 1981.

Descriptors: *Water demand, *Economic aspects, *Water supply, Budgeting, Capital, Costs, Financial feasibility.

Utility managers are engaged in constant efforts to reduce expenditures and control rate increases. It is suggested that water utility capital might be generated through capacity charges. Capacity charges are the costs of investment in major system components, such as transmission, pumping, treatment, and source of supply facilities for new customers. In the past these charges have been recovered through water rates. It is suggested that the concept of direct cost recovery be extended and applied, with service line and meter and distribution system charges, to charging for this required increase in capacity. This type of charge is also referred to as a buy-in charge. There is no set method to determine the amount which system capacity charges should recover. A number of alternatives can be used to recover these costs. Some include extension fees, connection charges, acreage fees, and availability charges. Even so these charges must not be viewed as a final or complete answer to current problems. The concept must be applied with concern for existing circumstances within a given utility. (Baker-FRC) W81-04117

6D. Water Demand

RATIONING A RIVER,

J. Boslough. Science 81, Vol 2, No 5, p 26-29, 34-37, June, 1981. 15 Fig.

Descriptors: *Available water, *Water scarcity, *Water allocation, River systems, *Colorado, *Arid lands, Irrigation requirements, Water shortage, Drought, Water deficit, Resource allocation, Water requirements, Irrigable land, Irrigation, Agriculture, Water delivery, Water demand, Forecasting, Water supply, Urban planning, Urban areas, Groundwater depletion, *Water management.

The first installment of a two-part series concerning the emerging Western water crisis, is focused upon the Colorado River system and the arid Southwest. In the arid West, water is more important than oil. There is barely sufficient water today in the Southwest to support the current population of close to 30 million, which is expected to double by the close of the century. Some analysts believe that water scarcity will soon curtail growth in Colorado's Front Range and southern California. Irrigation projects, dams, water tunnels, and aqueducts bring life to over 3.4 million acres of desert with annual crop yields exceeding a billion dollars. Without tunnels and desert aqueducts, cities like Phoenix, Denver, and Los Angeles would not exist. Energy-development plans for water use appear too ambitious, yet oil from shale is a pressing need. Groundwater withdrawal rate from the Ogallala aquifer will seriously affect present farm irrigation capability in the near term. River desalination by a Yuma reverse osmosis plant is planned to improve water quality, among other technological approaches to improve water yield. Cloud seeding to enhance snowfall can seriously affect mountain hamlets. Ultimately, the growing Colorado drought could produce the biggest resources crisis this country has yet experienced. (Zielinski-IPA) W81-04034

USUTU-VAAL WATER SCHEME ON STREAM, Power and Plant in Southern Africa (Johannesburg), p 3-4, 7, 10, January, 1980. 5 Fig, 2 Tab.

Descriptors: *South Africa, *Grootdraai Dam, *Vaal River, *Water supply development, Dam construction, Sasol II, Sasol III, ESCOM, Dam design, Future planning, Reservoirs, Aqueducts, Pumping plants, Cooling water.

The Usutu-Vaal Government Water Scheme is designed to supply water to Sasol II and III and to ESCOM, three large institutions essential for South Africa's fuel and energy needs. Sasol II and III will have an estimated water requirement of 200,000 cu m/d. ESCOM expects a 10.5% annual increase in electrical demand which will increase water demand for cooling, however, in the future ESCOM plans to switch to drycooling which requires less water than the currently used wetcooling. The first phase in supplying the required water is the construction of the Grootdraai Dam in the Vaal River. It will have a series of pump stations, rising mains and canals, and gravity mains to supply water to a balancing dam at Sasol II. Another balancing dam at Trichardt will supply water to ESCOM. Future phases call for the construction of storage dams on the Ngwenya, Hlilo, and Assegaaib River. The Grootdraai Dam will have an initial storage capacity of 364 million cu m. It will provide 160.5 million cu m of water to ESCOM and Sasol II annually. Construction began in 1976 with a total estimated cost of R52 million for this phase of the project. (Seigler-IPA) W81-04038

A WEB OF WATER SCHEMES FOR THE THIRSTY HIGHVELD, Construction in Southern Africa (Johannesburg) Vol 24, No 12, p 87-89, March, 1980. 1 Fig.

Descriptors: *South Africa, *Komati Usutu link scheme, *Electric powerplants, *Water supply, *Water supply development, Balancing reservoirs, Reservoir storage, Water requirements, Pipelines, Water transport, Conveyance structures, Weirs, Dams, Coal mines, Water conveyance.

The Komati-Usutu link scheme is a \$24 million link system between the various sources of water for the Eastern Transvaal power stations that will incorporate pump stations and pipelines to supply water to the Duvha and Matla power stations. The Trichardtsfontein balancing reservoir will be used to supply all power stations except Camden in the event of an emergency. The Witbank Dam will provide an additional balancing storage. The use of natural river courses to transport the water through the important coalfields of the area will provide a water supply to possible future power stations and coal mines. The scheme is keyed on a diversion weir on the Trichardtspruit that augments water supplies to the Matla Power Station by the use of a rising main. The weir will provide approximately 150,000 cu m/day. The rising main is capable of supplying 330,700 cu m/day so that water can also be supplied to Kriel during emergencies. Duvha is supplied by gravity-fed water from the reservoir at Hendrina. A pump station at the Witbank dam provides additional water to Duvha through a 4 km long rising main. The Komati River supply system will serve as a backup source for the Duvha, Komati, Hendrina, and Arnst poer stations. (Seigler-IPA) W81-04053

PERCEPTION INFLUENCES WATER CONSERVATION SUCCESS, California Univ., Berkeley, Dept. of Social and Administrative Health Sciences.

W. H. Bruvold. Water and Sewage Works, Vol 127, No 2, p 34-36, 58, February, 1980. 4 Tab, 10 Ref.

Descriptors: *Drought, *Water management, Social aspects, Psychological aspects, Conservation, Water use, Water use efficiency, Water metering, Water rates, Economic aspects, Water shortage, Water scarcity, Water supply, *Water conservation, California.

Nine water service districts were selected for a study to determine long-term water-use reduction resulting from emergency procedures adopted during the 1975-77 drought in California. Consumers managed to conserve great quantities of water during this time, as much as 50% in some cases. Economic incentives (penalty charges) were remarkably effective. Program effectiveness was evaluated by comparing water system records for the summers of 1976 and 1977. The percentage reduction based on water district estimates exceeded stated goals for districts with rigorous or moderate residential water conservation programs. Conservation goals for the districts with mild programs were not met. Rigorous residential conservation can reduce use from the range of 124-160 to 80 Gpcd (gallons per customer-day). Incentives for conservation can be applied by the use of an increasing block-rate pricing structure. This type of structure need place no upper limit on the amount used per month. Restrictive use rules would not be needed. (Baker-FRC) W81-04196

RESCUE AT PECAN GAP, Southwest and Texas Water Works Journal, Vol. 62, No. 12, p 6, March 1981.

Descriptors: *Drought, *Water supply, *Disasters, *Texas, Trucking, Tankers, Associated Milk Producers Incorporated, Water shortage, Pecan Gap.

Pecan Gap, a community in northeast Texas, was hard hit by drought in the summer of 1980. By August the lake which supplied water for over 200 families in the area was no longer usable. While a long term solution to the problem has not yet been reached, water for the emergency was supplied by a nearby town, and by cooperation with a milk producers' association and volunteer efforts on the part of the townspeople. The Associated Milk Producers have helped in several disasters in Texas, using their tank trucks to supply water to towns whose supplies have been damaged by weather emergencies. (Baker-FRC) W81-04236

LITTLE ROCK LOOKS TO THE FUTURE,

Field 6—WATER RESOURCES PLANNING

Group 6D—Water Demand

Little Rock Municipal Water Works, AR.
G. S. Allen.
Southwest and Texas Water Works Journal, Vol. 62, No. 1, p 8, 10, 11, 12, 14, April, 1980. 4 Fig, 4 Tab.

Descriptors: *Water resources development, *Water supply development, Institutions, Water requirements, Water demand, *Little Rock, Arkansas, Reservoirs, Water treatment, *Surface water availability, Water policy, Planning, Water allocation, Rivers, Water costs, Alternative planning.

The water system of the City of Little Rock, Arkansas, presently supplying about 70 mdg to its greater metropolitan area, is planning a 600% increase in water demand in the next 100 years. Since further development of groundwater supplies is not a viable alternative, the Arkansas River and Greers Ferry Lake are under consideration as future water resources. Although the Arkansas River has a large flow, water quality is variable and sometime poor, requiring expensive treatment. The Greers Ferry Reservoir, constructed by the Corps of Engineers, would involve reimbursement for capital and operation costs if reallocated for water supply. Several potential new impoundments and institutional arrangements are under consideration to achieve an adequate water supply at the lowest costs. Although additional water resources are not needed for 30 years, institutional organization must be developed early so that planning may proceed in the proper direction. (Cassar-FRC)
W81-04237

O & M DEFICIENCIES IN WASTEWATER SYSTEMS CAN BE SOLVED,
Camp, Dreser and McKee, Boston, MA. Management Consulting Div.
M. Lang.
Water and Wastes Engineering, Vol 17, No 1, p 30, 32, January, 1980.

Descriptors: Treatment plants, *Management planning, Personnel management, Operating policies, Mechanical failure, *Water treatment facilities, Waste water treatment, Operation and maintenance.

Poor management, organization, and administration may be a primary cause of operating and maintenance deficiencies in waste water treatment plants. The usual failures are really symptoms of managerial deficiency: lack of process expertise, inept operators, poor design or construction, inadequate personnel or supplies, and failure to implement industrial waste control. To avoid operational and maintenance failures, plants should be built to meet future demands. Personnel must be continuously trained, and management must plan maintenance schedules, safety procedures, rational inventory control, and timely procurement procedures. Contingency plans for equipment breakdowns must be developed. Change is inevitable and must be planned for. Utilities generally have a better record than municipalities in wastewater treatment because utility operation is more management oriented. (Small-FRC)
W81-04254

MONITORING, MANAGEMENT AND CONTROL OF IRRIGATION PROJECTS: THE EXAMPLE OF MWEA, KENYA,
Wye Coll., Ashford (England).
For primary bibliographic entry see Field 6A.
W81-04258

THE INFORMATION PROBLEM OF SOUTH INDIAN IRRIGATION CANALS,
Sussex Univ., Brighton (England).
For primary bibliographic entry see Field 6A.
W81-04259

NEGLECT OF O & M IN IRRIGATION, THE NEED FOR NEW SOURCES AND FORMS OF SUPPORT,
For primary bibliographic entry see Field 6A.
W81-04260

IMPROVING CANAL MANAGEMENT: THE ROLE OF EVALUATION AND ACTION RESEARCH,
For primary bibliographic entry see Field 6A.
W81-04262

HOW NOT TO LEARN FROM PILOT IRRIGATION PROJECTS: THE NIGERIAN EXPERIENCE,
Wye Coll., Ashford (England).
For primary bibliographic entry see Field 6A.
W81-04263

THE SOCIOLOGY OF IRRIGATION MANAGEMENT IN SRI LANKA,
For primary bibliographic entry see Field 6A.
W81-04264

6. Water Law and Institutions

UNITED STATES-CANADA GREAT LAKES WATER QUALITY AGREEMENT -- IMPACT ON U.S. POLICY,
International Joint Commission-United States and Canada, Windsor (Ontario).
K. H. Walker.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 37-42.

Descriptors: *Water quality, *International agreements, *International commissions, *Great Lakes, Governmental interrelations, Water pollution control, Land use, Phosphorus, Water quality standards, Urban drainage, Nonpoint pollution sources.

Intermittently since 1912, the International Joint Commission has undertaken investigations to determine the extent of pollution and degradation of the Great Lakes. The Commission's 1970 report provided a detailed assessment of water quality and made comprehensive recommendations for action by the Governments of Canada and the United States; this resulted in the Great Lakes Water Quality Agreement of 1972. The 1972 Agreement set into motion three major activities: the study of water quality in the Upper Lakes; the study of pollution from land use activities in the Great Lakes Basin; and the implementation of remedial measures to mitigate pollution from point sources. The Great Lakes Water Quality Agreement of 1978 reaffirmed the determination of Canada and the United States to restore and enhance the water quality of the Great Lakes system. Provisions of the agreement impact on United States programs involving construction grants, enforcement, NPDES permits, water quality standards, phosphorus control and removal, control of toxics, urban drainage, and point and nonpoint sources of pollution. The Water Quality Board and the Science Advisory Board provide opportunities for interrelationships between the United States and Canada and between the federal, state, and provincial governments. (Moore-SRC)
W81-03963

STATE/EPA AGREEMENTS: A STATE/FEDERAL PARTNERSHIP,
Environmental Protection Agency, Chicago IL. Region V.
D. Stringham.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs; Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. Environmental Protection Agency Report EPA-905/9-80-009, September, 1980. p 43-46.

Descriptors: *Water quality, *Governmental interrelations, *Interagency cooperation, *Environmental control, Economic efficiency, Great Lakes, Water pollution control.

The goals of the State/EPA Agreement (SEA) planning process are: to make the Federal and State governments partners in determining priorities for State and Federal funding assistance and technical assistance; to bring important environmental problems to the attention of senior management at both the Federal and State agencies; and to surface environmental problems that might not be covered by an individual environmental program and that may demand a creative mixing of funds from a number of programs. In addition, the Agreements may be an important vehicle for communicating the direction of EPA and State programs to the public. For the 1980 fiscal year, Agreements have been completed in all six Midwestern States. FY 1981 will see Michigan, Indiana and Ohio with Great Lakes SEA issues, and New York may also develop a Great Lakes SEA highlight in connection with a special regulatory assessment, and broad scale intensive survey of the Niagara River in New York. Both the draft Indiana and Ohio SEA's focus special problems in nearshore areas of the Great Lakes, estuaries, harbors and beaches which are seriously degraded due to point and nonpoint pollution. In all the State/EPA Agreements, specific tasks are assigned to the State and Federal partners, milestone schedules are established, and funding and responsible party assignments are settled. (Moore-SRC)
W81-03964

EPA REGULATORY/RESEARCH PROGRAM,
Environmental Protection Agency, Denver, CO. Region.
For primary bibliographic entry see Field 5B.
W81-03987

METAGAME ANALYSIS OF THE GARRISON CONFLICT,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
For primary bibliographic entry see Field 6A.
W81-04109

EPA POLICY ON LAND TREATMENT AND THE CLEAN WATER ACT OF 1977,
Environmental Protection Agency, Washington, DC.

R. E. Thomas, and S. C. Reed.
Journal of the Water Pollution Control Federation, Vol 52, No 3, p 452-460, March, 1980. 3 Tab, 10 Ref.

Descriptors: *Environmental policy, *Land disposal, *Political aspects, Environmental protection, Legislation, Reclaimed water, Municipal wastes, Waste water treatment, Grants, *Impaired water use, Costs, Evaluation.

The Environmental Protection Agency policy and construction grants program guidelines are discussed, and how they relate to the agency's issuance of the October 1977 policy statement on land treatment of municipal waste waters is examined. The history of federal water pollution control legislation is recounted, with emphasis on the October 1977 policy statement, its relationship to the Clean Water Act, and recent construction grants program guidance on land treatment. A November 1974 memorandum put EPA on record as preferring land treatment when cost effective and environmentally acceptable. AT the time of the October 1977 policy statement, EPA issued (with the Corps of Engineers and the Department of Agriculture) the 'Process Design Manual for Land Treatment of Municipal Waste water'. Recycling, reclamation, and reuse are basic policies outlined in the Clean Water Act of 1977. This act offers incentives to those who choose to implement alternative and innovative technologies, including land use. (Small-FRC)
W81-04135

MANAGEMENT CONTROL PLAN FOR PROTECTING GROUND-WATER QUALITY,
For primary bibliographic entry see Field 5G.
W81-04138

WATER RESOURCES PLANNING—Field 6

Ecologic Impact Of Water Development—Group 6G

FLOODPLAIN REGULATION IN ONTARIO: AN ANALYSIS OF EXISTING AND PROPOSED POLICY IN THE GRAND AND CREDIT RIVER WATERSHEDS, Waterloo Univ. (Ontario). Dept. of Geography. J. Gardner, and B. Mitchell.

Journal of Environmental Management, Vol 11, No 2, p 119-131, September, 1980. 2 Fig. 2 Tab, 10 Ref.

Descriptors: *Regulation, *Flood plain zoning, *Watershed management, Flood control, Flood protection, Legal aspects, Flood plains, Land management, *Ontario.

The evolution of floodplain management in Ontario is reviewed since its inception in the early 1940's. Changes to the floodplain management program proposed in 1977 by the Ontario government are examined and evaluated. Examples for these analyses are taken from the Grand and Credit River watersheds. One of the proposed changes would divide floodplains into a floodway and a flood fringe. On the flood fringe area more extensive use of the land would be permitted if downstream settlement would not be adversely affected and provided regulations concerning flood-proofing were met. The second change calls for giving municipalities greater scope to allow the use of flood fringe areas. The purpose of these changes is to allow increased but controlled development in urban areas faced with ever-increasing land values. Problems arise in that jurisdiction over the riverine lands in Ontario would be unclear under the planned plan. The second problem concerns financial arrangements, which are biased toward structural solutions tending to encourage development in flood-prone areas. Due to a general lack of enforcement procedures, questions arise concerning the manner in which the use of the land is to be carefully monitored. (Baker-FRC)

W81-04160

IMPLEMENTATION OF EPA'S MUNICIPAL COMPLIANCE PROGRAM, Environmental Protection Agency, Washington, DC. Office of Water Enforcement. D. L. Guthrie, G. R. Polvi, and D. N. Lyons. Journal of the Water Pollution Control Federation, Vol. 52, No. 8, p 2090-2097, August, 1980. 5 Tab, 16 Ref.

Descriptors: *Municipal waste water, *Waste water treatment, *Legal aspects, Compliance, Permits, Water pollution control, Federal jurisdiction, Political aspects, Environmental Protection Agency.

The Environmental Protection Agency (EPA) has developed a National Municipal Policy and Strategy (NMPS) which is designed to achieve full municipal waste water treatment compliance nationally, to commit allotted Federal construction grant funds, and to issue ocean disposal permit extensions and modifications allowed by the Clean Water Act. To meet these goals, the NMPS defines a process for issuing extensions with enforceable compliance schedules based on grant funding; lays the foundation for the coordination of grant, permit, and enforcement operating practices; and describes enforcement and grant actions as they relate to State Project Lists. These mechanisms contain the following our elements: (1) development of a municipal noncompliance classification process; (2) provision of enforcement/grant procedures for facilities requiring treatment more stringent than secondary; (3) introduction of a municipal referral priority system; and (4) authorization of formulation of a municipal management system to implement NMPS. Despite large Federal municipal grant expenditures, about 65 percent of all major publicly owned treatment works were in noncompliance with municipal pollution abatement regulations as of July 1, 1977. The municipal management system combines a range of compliance, enforcement, and construction grant actions with a system ranking candidate municipalities for judicial action in an attempt to coordinate national compliance efforts. (Carroll-FRC)

W81-04171

Environmental Protection Agency, Washington, DC. Office of Drinking Water. For primary bibliographic entry see Field 5F. W81-04195

A DISCUSSION OF THE RESPONSIBILITIES OF A WATER BOARD MEMBER, Camp, Dresser and McKee, Inc., Boston, MA. Management Consulting Div. C. P. N. Woodcock, D. Laredo, 2nd., and P. R. Brown.

Journal of the New England Water Works Association, Vol 94, No 3, p 255-263, September, 1980.

Descriptors: *Water quality management, *Water districts, Public participation, Professional personnel, Policy making, Financial feasibility, Planning, Water management.

The implementation of policy and the operation of a water utility are areas Water Boards of Directors cannot ignore. These two areas are important because of the escalating costs of providing safe, high-quality water at adequate pressures, increased consumer awareness and collateral demands for public accountability, growing awareness of the limits of water resources, and increased government regulation of utilities. Proper control requires information, and a capable Executive Administrator is needed to see that information is presented to the Directors. Board members can exercise their responsibility in overall planning, policy-making, and finance. Boards must be provided with information reports prepared by professional staff so that informed decisions can be made. (Small-FRC)

W81-04218

OKLAHOMA LOOKS AHEAD TO YEAR 2040, Southwest and Texas Water Works Journal, Vol. 62, No. 7, p 5, October, 1980.

Descriptors: *Water resources development, *Water requirements, *Water transfer, *Water conveyance, Planning, Water supply, *Oklahoma, State governments, Legal aspects, Water law, Arkansas River, Red River, Oklahoma comprehensive water plan.

The Oklahoma Comprehensive Water Plan, authorized in 1974 and presently in the process of debate and refinement, will address the state's future water needs. Projected water use for the year 2040 is 6.9 million acre-feet per year (present use, 2.4 million acre-feet per year). Development of resources to meet these needs is estimated at 11 billion 1978 dollars, not including local facilities. Plans include three conveyance systems (from the Arkansas River and the Red River Basin) to conduct water from the eastern part of the state, where rainfall average 56 inches annually to the arid west. This development will compensate for the rapidly depleting Ogallala Aquifer. (Casser-FRC)

W81-04242

PRACTICAL EXPERIENCE OF IRRIGATION REFORM, ANDHRA PRADESH, INDIA, S. H. Ali.

Water Supply and Management, Vol 5, No 1, p 19-30, 1981.

Descriptors: *Irrigation, *Planning, Water management, Legislation, Management planning, Long-term planning, Project planning, Legal aspects, Jurisdiction, Water supply, Water distribution, *India.

Irrigation and water management is a significant topic of discussion in Third World countries. Problems and obstacles encountered during attempts to implement irrigation reform in the state of Andhra Pradesh, India, are discussed. One of the major obstacles encountered at the start was in the appointment of certain officials who, by virtue of the bureaucratic caste system operating in the area, were inappropriate for the task entrusted to their authority. The inappropriateness of the appointments made it difficult and sometimes impossible to secure the proper cooperation needed to achieve success. A second initial problem involved a misconception in the minds of the people and officials

as to who had control over what, for which a very poor system of communication was responsible. Problems were also encountered in attempts to pass needed legislation and secure funds for work to begin. Many improvements and changes were introduced into the system as it currently existed. Efforts to rationalize administrative coordination at the state and project level are discussed. (Baker-FRC)

W81-04237

'AND THE WINNERS ARE...', T. Kish.

Journal of the Water Pollution Control Federation, Vol 52, No 8, p 2076-2081, August, 1980.

Descriptors: *Secondary waste water treatment, *Ocean dumping, *Water quality standards, Regulations, Waivers, Waste water treatment, Effluents, Waste disposal, Environmental protection, Legal aspects.

Federal legislation currently permits a marine discharger to acquire a waiver from mandatory secondary waste water treatment if it can be shown that the effluent will not harm the ocean environment. Of the 70 coastal communities which are awaiting decisions from the U.S. Environmental Protection Agency (EPA) with respect to waiver applications, 36 have proposed upgradings and 14 have requested waivers on the basis of existing discharges. The waiver applications are required to include a large amount of information on environmental impact, plans for controlling toxic pollutants, proposed monitoring programs, applicable state water quality standards, and other items. These applications are both lengthy and costly to prepare, presenting a hardship for small communities. Evaluation of the applications by EPA is also time-consuming and expensive, and appeals of EPA decisions are expected. Environmentalists are concerned about the potential for discharge of toxic chemicals from non-point sources into the oceans. Costs related to the construction of new secondary treatment facilities when waivers are not granted or to the construction of proposed outfalls or modifications when waivers are granted may render all decisions meaningless due to lack of funding. (Carroll-FRC)

W81-04271

6G. Ecologic Impact Of Water Development

FRESHWATER NEEDS OF FISH AND WILDLIFE RESOURCES IN THE NUECES-CORPUS CHRISTI BAY AREA, TEXAS: A LITERATURE SYNTHESIS, North Texas State Univ., Denton. Inst. of Applied Sciences.

D. E. Henley, and D. G. Rauschuber.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-211997, Price code: A19 in paper copy, A01 in microfiche. Fish and Wildlife Service, Biological Services Program, Report FWS/OBS-80/10, March, 1981. 434 p, 197 Fig, 88 Tab, 336 Ref, 3 Append. 14-16-0009-77-074.

Descriptors: *Water requirements, *Wildlife habitats, *Dam effects, *Saline water, *Environmental effects, River flow, Fisheries, Port facilities, *Estuarine environment, Alteration of flow, Runoff, Urban runoff, Effluents, Salinity, Salt marshes, Vegetation, Fauna, Ecology, Growth stages, Nueces-Corpus Christi Bay System(Texas), Environmental protection.

The highly variable environment of the Nueces-Corpus Christi Bay System in Texas is subject to many extremes, including the effects of freshwater runoff from rural and urban areas; creeks and rivers; rainfall directly on the bay surface; and effluent return flows from various industrial, domestic, and agricultural users. The ecological impacts of the proposed construction of Choke Canyon Reservoir and Harbor Island Deep-Water Port on the Nueces-Corpus Christi Bay System were investigated with emphasis on the freshwater needs of the System. The construction of Choke

Field 6—WATER RESOURCES PLANNING

Group 6G—Ecologic Impact Of Water Development

Canyon Reservoir will reduce the amount of freshwater inflow entering the Nueces-Corpus Christi Bay System from the Nueces River Basin. The systems operation of Choke Canyon Reservoir and Lake Corpus Christi will reduce the average annual inflow to the estuarine system by 35%. An inflow/salinity analysis showed that construction of the reservoir will increase the frequency of high salinities in Nueces Bay. Salinities in Corpus Christi Bay will also increase, although to a lesser extent. Significantly increased salinity would probably cause a shift in vegetation species to those more tolerant of salinity in the deltaic marsh, and the biomass of animal populations within both the marsh and seagrass biotopes could be altered qualitatively. Reduced freshwater inflows would probably have an effect on commercial fisheries harvests because of the loss or alteration of suitable nursery areas for the development of larval, post-larval, and juvenile forms of shellfish and finfish. (Moore-SRC)
W81-04019

A FUNCTIONAL CLASSIFICATION OF WETLANDS,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2A.
W81-04020

EFFECTS OF IMPOUNDMENTS IN MARSHES ON WILDLIFE AND FISHERIES,
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
R. H. Chabreck.

In: Proceedings, U.S. Fish and Wildlife Service Workshop on Coastal Ecosystems of the Southeastern United States, Big Pine Key, Florida, 18-22 February 1980, Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-80/79, February, 1981, p 21-29, 15 Ref.

Descriptors: *Reservoirs, *Marsh management, *Brackish water, *Fishes, *Wildlife habitats, Salinity, Water level, Coastal marshes, Fish, Water birds, Waterfowl, Fauna, Crayfish, Tidal effects, Marsh impoundments, Environmental effects.

Marsh impoundments of coastal areas control water levels and salinities for the purpose of wildlife habitat improvement, aquaculture, water storage for irrigation and industrial uses, mosquito control, and navigation. Impoundments categorized by water level and salinity regimes include four types; permanently flooded with freshwater, manipulated freshwater, permanently flooded with brackish water, and manipulated brackish water. Each type of impoundment is evaluated in regard to major groups of sport and commercial wildlife and fish species including waterfowl, coots, gallinules, rails, wading birds, fur bears, alligators, freshwater fishes, estuarine fishes, and crayfish. The vegetational and hydrological characteristics of coastal wetlands are primary factors regulating their value to wildlife and fisheries resources. Vegetation produced on wetlands serves as the primary food source and often determines the number and species that an area will support. Hydrological factors such as water salinity and tidal action may affect species tolerance to a particular habitat or regulate the means by which access is gained to the area. (Moore-SRC)
W81-04022

REDUCED FRESHWATER INFLOW IMPACTS ON ESTUARIES,

Fish and Wildlife Service, Austin, TX.
N. A. Funicelli, and H. M. Rogers.
In: Proceedings, U.S. Fish and Wildlife Service Workshop on Coastal Ecosystems of the Southeastern United States, Big Pine Key, Florida, 18-22 February, 1980, Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/79, February, 1981, p 214-219, 20 Ref.

Descriptors: *Estuarine environment, *Salinity, *Productivity, *Reservoir releases, *Flow control, *Biota, Habitats, Nutrients, Detritus, Fish, Shellfish, Marsh plants, Growth stages.

Estuarine productivity is closely related to the quality, quantity, and timing of its freshwater in-

flows. Freshwater inflows act as a transport system for sediments, nutrients, and detritus; they increase the amount of salinity habitats and hydrologically alter salinity gradients deemed essential for coastal biota maintenance. Decreased freshwater inflows to estuaries can have significant adverse impacts on the ecosystem. Marsh plants are significantly impacted by the magnitude, distribution and timing of marsh inundation. Upstream reservoir regulation reduces freshwater discharges and alters the timing, magnitude, and duration of marsh inundation. Freshwater inflow reductions affect pelagic shellfish environments by modifying salinity and nutrients, and therefore, possibly the habitats of certain shellfish life stages. Small increases in salinities caused by reductions in freshwater inflows should not cause significant changes in finfish populations. Site specific changes in the secondary and tertiary bay margins, bayous, and marshes are likely to be greater than changes in the average salinities. The most serious impact is likely to be the loss of suitable habitats required for most finfish in their larval or juvenile stages. (Moore-SRC)
W81-04025

EFFLUENT CREATES AN OASIS IN NEVADA,
Clark County Sanitation District, Las Vegas, NV.
For primary bibliographic entry see Field 5E.
W81-04156

TOXICITY OF DISSOLVED OZONE TO FISH EGGS AND LARVAE,
Massachusetts Univ., Waltham. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W81-04176

ENVIRONMENTAL ASPECTS OF THE YARE BASIN FLOOD CONTROL STUDY,
Anglian Water Authority (England). North and Suffolk River Div.
M. G. W. Bell.

Journal of the Institution of Water Engineers and Scientists, Vol. 35, No. 1, p 66-72, January, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Water quality, *Flood control, Barriers, Agriculture, Land use, Surges, Tidal effects, Environmental effects, *Yare River Basin, Recreation, Ecology, Watershed management, Water control, Saline water barriers, Nutrients, Eutrophication, United Kingdom.

The beneficial effects of the proposed Yare River Basin Flood Control program are protection from tidal surges such as occurred in January 1953, increased land for agricultural and grazing use, and formation of vegetation to replace a disappearing macrophyte population. Negative effects, not considered significant, include reduction in groundwater levels, increased nitrogen input from fertilizer use, and elimination of tidal flushing action downstream of the barrier. This basin includes a former peat digging, Broadland, now artificially drained and widely used for water recreation (boating and fishing) and as a water supply. Present water quality in this basin is classed as unpolluted or of doubtful quality, the latter a result of the sluggish flow rather than any artificial pollution. (Cassar-FRC)
W81-04226

SOME FACTORS AFFECTING THE DISTRIBUTION AND ABUNDANCE OF THE TWO MELANIAN SNAILS, SEMISULCOSPIRA DECIPIENS AND S. RETICULATA, IN LAKE BIWA,

Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
For primary bibliographic entry see Field 2H.
W81-04280

7. RESOURCES DATA

7A. Network Design

WATER MONITORING PROGRAM - PLANNING FOR 1981,
Environmental Protection Agency, Chicago, IL. Region V.

W. H. Sanders, III.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-176646, Price codes: A17 in paper copy, A01 in microfiche. In: Seminar on Water Quality Management Trade-Offs, Point Source vs. Diffuse Source Pollution, September 16-17, 1980, Chicago, Illinois. EPA Agency Report EPA-905/9-80-009, September, 1980, p 293-299.

Descriptors: *Monitoring, *Water quality control, *Planning, *Priorities, Public health, Toxicity, Pollutants, *Water pollution control, Effluents, Quality control, Data collections.

Water monitoring plans are being developed in EPA Region V based on the renewed emphasis on the human health aspects of water pollution control, and an assessment of the adequacy of existing monitoring networks and programs within the Region. Problem existing in Region V include: lack of information entered into the STORET data base; possible excess of fixed monitoring stations; use of intensive surveys for single programs rather than multiple purposes; and insufficient monitoring of toxic substances because of lack of resources. The Basic Water Monitoring Program is directed to the protection of the public health through monitoring of toxic and hazardous sources of pollution, and the more traditional pollutants. The components of the program are: ambient monitoring (including toxic monitoring), effluent monitoring, intensive surveys, biological monitoring, quality assurance and STORET. (Brambley-SRC)
W81-03980

FACTORS TO CONSIDER IN THE DESIGN OF A WATER QUALITY MONITORING NETWORK.

Colorado State Univ., Fort Collins.

T. G. Sanders, and R. C. Ward.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium: Sampling, Analysis and Quality Assurance, Mar 26-28, 79, Denver, CO. EPA Report EPA-600/9-80-022, Jun 80, p 343-354, 2 Fig, 11 Ref, OWRT-B-186-COLO(3).

Descriptors: *Network design, *Monitoring, *Water quality data, *Sampling, Data acquisition, Water analysis, Water quality management, Statistical methods, River systems.

The five functions of a monitoring system are identified as sample collection, laboratory analysis, data handling, data analysis, and information utilization. These functions must be incorporated in the design of a monitoring network, in which the design has three major components: selection of water quality variables to monitor; sampling location; and frequency. The water quality variables should be specified first in new monitoring networks, but can be added into existing networks. The location of permanent sampling stations in a water quality monitoring network is probably the most critical aspect of the network design. The procedure for locating sampling stations is derived by determining the centroid of a river system. Once the reach of the river has been specified, the specific point in the reach may be identified for sampling. This should be in the zone of complete mixing. The sampling frequency is determined by the need to have samples representative in time. While the frequency is often based on professional judgement or cost constraints, there are statistical procedures to specify sampling frequency. It is important in network design that all aspects of the monitoring program should match in terms of accuracy. (Brambley-SRC)
W81-03994

RESOURCES DATA—Field 7

Data Acquisition—Group 7B

MINICOMPUTER, MICROPROCESSOR AND TELECONTROL APPLICATIONS TO A WATER SUPPLY NETWORK,
East Worcestershire Water Co. (England).
For primary bibliographic entry see Field 6A.
W81-04165

EXPERIENCES IN THE CONTINUOUS MONITORING OF RIVER WATER QUALITY,
Thames Water Authority, London (England).

D. C. Hinge.

Journal of the Institution of Water Engineers and Scientists, Vol 34, No 6, p 546-556, November, 1980. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Monitoring, *Water quality, Hydrologic data collections, Evaluation, Operating costs, Laboratory equipment, Water analysis, Pollutant identification, Ammonia, Nitrates, Water temperature, Conductivity, Suspended solids, Telemetry, Cost analysis, Economic aspects, *England.

Experiences in the continuous automated instrumental monitoring of river water quality in England are described. Eleven years' experience at five stations in the Lea Division indicates that satisfactory results can be obtained from commercial equipment. The performance of monitors is reliable on rivers containing high proportions of good quality sewage effluent. Such monitoring systems require qualified technical staff and telemetry with centralized data processing. From five stations the cost per water measurement averages 10 pence; laboratory procedures cost twenty times more. (Titus-FRC)
W81-04200

7B. Data Acquisition

THE USE OF COMMUNITY PARAMETERS DERIVED FROM ELECTROFISHING CATCHES OF RIVER FISH AS INDICATORS OF ENVIRONMENTAL QUALITY,
DePauw Univ., Greencastle, IN. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W81-03984

EPA'S QUALITY ASSURANCE PROGRAM FOR WATER AND WASTE ANALYSIS,
Environmental Monitoring and Support Lab., Cincinnati, OH.

J. A. Winter.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, Colorado. Environmental Protection Agency Report EPA-600/9-80-022, June, 1980. p 3-11, 5 Tab, 4 Ref.

Descriptors: *Water quality, *Water analysis, *Water quality control, Standards, Evaluation, Testing procedures, Drinking water, Samples, *Water quality standards, Environmental protection, Agency.

The EPA has established a quality assurance program to assure that measurements of environmental samples are reliable, and hence, legally defensible, through development and implementation of uniform quality control procedures. The program for water/waste water analyses includes: development of manuals and guidelines; provision of quality control check samples to within-laboratory quality assurance programs for all parameters under the laws; conducting formal method validation studies for all parameters under the laws; conducting performance evaluation studies for laboratory approval and/or certification; and equivalency of alternate test procedures. Reference-type samples are used in method selection and validation, intralaboratory quality control, and performance evaluation and certification. The samples available for water quality and drinking water analyses and those in preparation are listed. A permanent repository for these samples is being established. The procedures for gaining acceptance for

limited and nation-wide use of alternate test procedures are itemized. (Brambley-SRC)
W81-03986

BIOLOGICAL MONITORING METHODOLOGIES FOR OIL SHALE AREA SURFACE WATERS WITH EMPHASIS ON MACROINVERTEBRATE SAMPLING TECHNIQUES.
Environmental Monitoring Systems Lab., Las Vegas, NV.

W. L. Kinney, C. E. Horning, and J. E. Pollard. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221435, Price codes: A99 in paper copy, A01 in microfiche. In: Oil Shale Symposium; Sampling, Analysis and Quality Assurance, March 26-28, 1979, Denver, CO. EPA Report EPA-600/9-80-022, June, 1980. p 506-517, 1 Fig, 17 Ref.

Descriptors: *Biomonitoring, *Oil shale, *Environmental effects, *Benthic fauna, Sampling, Macroinvertebrates, Water pollution sources, Coal mining, Statistics, Riffles, Water quality management, *White River, Utah, Colorado.

There exists a pressing need for reliable biological sampling methodologies applicable to streams of the semi-arid west. This is particularly relevant for rivers such as the White and Yampa which are potentially subject to nonpoint pollution impact as a result of oil shale and coal development. The efficiency of two types of artificial substrate samplers (basket and multiple-plate), the Surber sampler, and variations of a traveling-kick method was evaluated for describing macroinvertebrate communities representative of the White River, Utah and Colorado. Basket samples provided the largest number of animals per sample, while the kick method provided data with the best statistical reproducibility. Multiple-plate and Surber samples provided highly variable results in terms of the number of animals and taxa collected. The kick technique was effective in riffle areas where the bottom fauna was particularly sparse and where a prohibitive number of Surber or multiple-plate samples would be required to adequately describe the benthic community. The advantage of biological monitoring in providing a mechanism for the integration of conditions between sampling periods, and the need to incorporate biological components into comprehensive water quality monitoring programs are noted. (Brambley-SRC).
W81-03997

CONTINUOUS MONITORING OF ANIONS IN FEEDWATER BY ELECTRICAL CONDUCTIVITY.

Illinois State Water Survey, Urbana.
R. W. Lane, F. W. Soilo, and C. H. Neff.
In: Water and Steam-Their Properties and Current Industrial Applications. Straub, J. and Scheffler, K., editors. Pergamon Press, Oxford and New York, p 672-679, 1980. 4 Fig, 5 Ref, Append.

Descriptors: *Steam turbines, *Measuring instruments, *Anions, *Feedwater treatment, Steam, Turbines, Acidic water, Chlorides, Sodium, Sulfate, Condensates, Corrosion, Deterioration, Cracks, Water quality, Monitoring.

Deposits of chloride, sulfate, and sodium in large utility turbines, and the occurrence of stress corrosion cracking of turbine blades, have determined limits of steam purity at < 5 ppm for each of these constituents. Monitoring steam impurities in once-through boilers, where many of the turbine failures have occurred, can be done most effectively by sampling the feedwater. This method replaces the more complicated method of sampling steam effluent, since the dissolved impurities essentially remain dissolved throughout the system, including in the steam effluent. This report describes two newly designed instruments to monitor the feedwater: a Feedwater Analyzer to measure anion conductivity accurately and at low temperatures, and a portable Condensate-Electric Boiler to detect condenser leakage. Using these instruments, changes can be observed during actual plant changes in operation. Usually a norm is established, and when gradual, sudden and/or continued rises in conductivity occur they can be traced

to a particular unit. Much of the corrosion or deposits in turbines occur during start-up or shutdown. With this knowledge, alterations in those procedures can be prescribed. A computer program is given for calculating the ammonia and carbon dioxide in pure water systems of varied pH, conductivity, and temperature. (Garrison-Omniplan)
W81-04028

U FINGERPRINTS IN GROUNDWATER.
For primary bibliographic entry see Field 2F.
W81-04041

DISPERSION COEFFICIENT OF THE KOEBERG AQUIFER.
For primary bibliographic entry see Field 2F.
W81-04042

SOME PRELIMINARY OBSERVATIONS ON THE SUBMERGED AQUATIC ZOSTERA CAPENSIS SETCHELL,
University of Durban-Westville (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W81-04056

NOTE ON THE TIME TO FLOOD EXCEDENCE,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology, Vol 49, No 3/4, p 395-399, February, 1981. 1 Tab, 5 Ref.

Descriptors: *Flood recurrence interval, Dams, Hydrology, Poisson distribution, Mathematical studies, *Flood data, Flood flow, Model studies, Flow magnitude.

A simple non-parametric approach is outlined which will allow one to calculate the expected lifetime of a 'permanent' structure in a river environment, assuming that that structure will be destroyed or seriously damaged by a flood greater than some critical magnitude. The statistical methods employed in this approach are well known but do not appear to have been used before to handle flood data. This approach is concerned with a specified flow magnitude, above which problems will develop, and confidence bounds which are always stated with respect to a single return period. This is in contrast with the extreme value approach, which yields a relationship between flow magnitude and return period over a range of values. However, this latter technique requires a record of annual maxima to be available, and these maxima are assumed to follow one of the extreme value distributions. (Baker-FRC)
W81-04073

THE APPLICATION OF GAMMA-RAY ATTENUATION TO THE DETERMINATION OF CANOPY MASS AND CANOPY SURFACE-WATER STORAGE.
University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics.
B. Olszyczka and J. M. Crowther.
Journal of Hydrology, Vol 49, No 3/4, p 355-368, February, 1981. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Canopy, *Water storage, Surface water, Trees, Forests, Gamma radiation, Hydrology, Measuring instruments, *Gamma radiation.

The feasibility of using a nuclear method to make non-destructive measurements of both fresh canopy mass and canopy surface-water storage was investigated. The gamma-ray attenuation method was employed. The agreement between the measured and weighed estimates of the mass per unit area of dry foliage within the sampled volume indicated that the exponential attenuation equation for gamma rays can indeed be applied to an inhomogeneous absorber such as foliage. If the foliage remains fixed, uncertainties in the gamma-ray estimates of mass per unit area of foliage for any one beam path are determined by counting statistics.

Field 7—RESOURCES DATA

Group 7B—Data Acquisition

tics, and, in the case of foliage, by the choice of attenuation coefficient. In this experiment uncertainties in counting statistics were small. The experiment to determine the usefulness of this method was conducted for Sitka spruce of average height 12 m. The canopy was saturated artificially with water, and a canopy storage capacity of 2.4 mm was estimated. (Baker-FRC)
W81-04074

LYSIMETER FOR MEASURING ARID-ZONE EVAPOTRANSPIRATION,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis.
Journal of Hydrology, Vol 49, No 3/4, p 385-394, February, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Lysimeters, *Soil water, Soil moisture meters, Moisture meters, Soil physical properties, Moisture content, Moisture availability, Hydrologic budget, Hydrology, *Evapotranspiration, *Arid zone.

The detailed design and construction phases of the original monolith hydraulic weighing system lysimeter are described, along with information on the inherent difficulties encountered and the modification and conversion of the lysimeter to the electronic transducer assembly. The monolith weighing lysimeter used gave a high degree of sensitivity, approaching that of the more complex and costly beam-balance lysimeter. The transducer package remained in continuous operation for over a year with no malfunctions. The sensitivity of the transducer package and time response are very good. Data gathered using the monolith weighing lysimeter compared favorably with the soil-moisture balance data obtained from neutron probe measurements. Under the extreme temperature conditions encountered in the desert environment, the design as described functioned well. (Baker-FRC)
W81-04080

THE WEATHER REPORT PREDICTS RAIN,
New Haven City, CT.
H. F. Goetz, Jr.
Water and Wastes Engineering, Vol 17, No 1, p 39-40, January 1980. 2 Fig, 1 Tab.

Descriptors: *Frequency analysis, *Graphical analysis, *Rainfall, Rainfall intensity, Rainfall distribution, Meteorological data collection, *Connecticut.

Frequency analysis was used to estimate rainfall in Connecticut. Graphs have been compiled of the rainfall frequency curves which establish relationship between total rainfall, duration of rain, and frequency of rainfall. When a storm occurs, the amount of rainfall and the time period can be determined, and the rainfall frequency curves can be used to rate the storm in terms of its meteorological frequency. Intensity-duration graphs based upon frequency analysis by the method of extreme values were plotted. This type of graph relates three variables: rainfall intensity, return period or frequency, and duration or time of concentration, for the New Haven, Connecticut, watershed. Examples reveal that the storm may have only one return period in terms of meteorological data, while the same storm may result in a number of return periods of varying severity depending upon the time of concentration of the individual watershed. Also, since the intensity ranking of storms does not consider the areal pattern of storms, it may not give the same results as obtained from a frequency-discharge curve for a particular watershed. (Small-FRC)
W81-04145

THE POTENTIAL OF SATELLITE AND AIRCRAFT REMOTE SENSING TECHNIQUES TO MARINE AND COASTAL POLLUTION MONITORING
Dundee Univ. (Scotland). Tay Estuary Research Center.
J. A. Charlton.
Progress in Water Technology, Vol 12, No 4, p 687-693, 1980. 1 Fig 12 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Measuring instruments, Surveying instruments, Microwaves, Ocean waves, Water level recorders, *Water pollution, Monitoring, Coastal waters, Suspended sediments, Chlorophyll, Water temperature.

Satellite data which is useful to the marine scientist is discussed, including that of the Seasat A and Nimbus 7 satellites, which carried delicate oceanographic instruments. The instruments used were developed as part of the space program and include optical instruments which receive radiation from the earth as well as others which work on a radar principle and detect microwaves. The Nimbus 7 carried a coastal zone color scanner, which is a multi-spectral scanner used to quantify suspended sediments, chlorophyll, yellow substances, and sea surface temperature. The Seasat A carried a synthetic aperture radar, which looks at sea surface level differences. The data gathered has been used to develop algorithms. The detection of oil slicks has been attempted, although aircraft seem more suitable for this because of the relatively small size of the slicks. Problems with the present systems include the fact that only the upper layer of the ocean is seen by the instruments and that cloud cover can interfere with many of the instruments. (Small-FRC)
W81-04206

APPLICATION OF A SIMPLE DIAGNOSTIC CLOUD MODEL TO THE 20 MAY 1977 STORMS OVER THE OKLAHOMA MESONETWORK,
Wisconsin Univ.-Milwaukee.
S. U. Park, and D. N. Siskar.
Tellus, Vol 32, No 4, p 326-339, 1980. 15 Fig, 22 Ref.

Descriptors: *Model studies, *Storms, Rainstorms, Heat, Vortices, Clouds, Cloudbursts, Energy, Rainfall distribution, Forecasting, *Oklahoma, Meteorological data collections.

The purpose of this study was to investigate the modification of the preassigned mass distribution function and making use of conservation quantities. The storm situation existing on 20 May 1977 was used as the study case. Using this severe storm the average mesoscale environmental properties such as mass, moisture and vorticity that produce heavy rain have been computed. The vertical distributions of the apparent heat source and the moisture sink in the storm complex were similar to those found in tropical regions. A large apparent vorticity sink was found in the upper divergent layer which cannot be explained by the vertical transport of vorticity due to the cumulus-convection mechanism alone. The rainfall estimated by the condensation rate of the cloud model presented agrees fairly well with that observed on the ground. The total energy of the storm system was largely supported by the latent heat release. (Baker-FRC)
W81-04232

EVALUATION OF IONIC STRENGTH AND SALINITY OF GROUNDWATERS: EFFECT OF THE IONIC COMPOSITION,
Institute of Agricultural Chemistry, Bari (Italy). M. Polemio, S. Bufo, and S. Paoletti.
Geochimica et Cosmochimica Acta, Vol 44, No 6, p 809-814, 1980. 6 Tab, 18 Ref.

Descriptors: *Ions, *Salinity, *Groundwater, Water analysis, Chemical analysis, Chemical properties, Conductivity, Mathematical studies, Dissolved solids, Water quality, *Electrolytic conductivity.

A simple, rapid method was developed to measure ionic strength and salinity of groundwater. Required parameters are electrolytic conductivity and total solute concentration. These are used in an empirical equation which holds over a wide concentration and composition range. A simplified form of this equation is used to determine ionic strength from conductance and colligative measurements. The ratio of ionic strength to total solute molar concentration indicates the ratio of bivalent to monovalent ions. (Cassar-FRC)

W81-04284

7C. Evaluation, Processing and Publication

DYNAMIC MODELING OF INDUSTRIAL WASTE WATER TREATMENT PLANT DATA,
Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5D.
W81-04173

DISTRIBUTION SYSTEM MAPS AND RECORDS,
Tulsa City Dept. of Water and Sewer, OK.
A. J. Hamlett, Jr.
Southwest and Texas Water Works Journal, Vol. 62, No. 9, p 19-20, December, 1980 3 Fig.

Descriptors: *Mapping, *Water distribution, Urban mapping, Data collections, Hydrants, *Tulsa, Oklahoma, *Water supply systems, Water mains.

Accurate, simple, flexible maps are necessary for proper management of a water distribution system. The Tulsa, Oklahoma, system currently contains 1,663 miles of mains, 11,000 fire hydrants, and 123,000 meters. The present mapping system is described in detail. Recorded on an atlas system using sheets 16 inches by 31 inches, scale 1 inch to 200 feet, copies are maintained for use by key personnel. Fire hydrant maps use a scale of 1 inch to 600 feet, and large distribution main maps, 1 inch to 2,000 feet. (Cassar-FRC)
W81-04235

THE STRUCTURE AND WORK OF THE DOE/NWC STANDING COMMITTEE OF ANALYSTS,
Department of the Environment, London (England). Water Pollution Div.
For primary bibliographic entry see Field 5A.
W81-04274

8. ENGINEERING WORKS

8A. Structures

USUTU-VAAL WATER SCHEME ON STREAM,
For primary bibliographic entry see Field 6D.
W81-04038

SETTLEMENT OF A COMPACTED UNSATURATED EARTH EMBANKMENT,
University of the Witwatersrand, Johannesburg (South Africa).
For primary bibliographic entry see Field 8D.
W81-04043

MASSIVE COOLING TOWERS FOR MIGHTY DUVHA,
Construction in Southern Africa, Vol 24, No 12, p 31, March, 1980. 2 Fig.

Descriptors: *South Africa, *Cooling towers, *Electric power production, *Coal, *Concrete construction, Electric power plants, Cooling water, Cost analysis, Piles, Foundations, Contracts, Civil engineering, Duvha Power station.

Work is in progress on the last three cooling towers at Duvha power station in South Africa, one of the two largest coal-fired power stations in the world. The towers will have a diameter of 114 m at ringbeam with a height of 147 m. The station will have six generating sets, each rated at 600 mw, for a total installed capacity of 3,600 MW. LTA Civil Engineering has a R7 million subcontract for the construction of the final three towers. LTA's usual construction time of 12 months from ringbeam to top-out of the shell should have all three towers completed by February 1984. LTA has done R50 million of work at Duvha including the construction of: various foundations and sub-foundations, blowdown sumps, control and computer

Hydraulic Machinery—Group 8C

rooms, offices, ash line plinths, and many other facilities. Construction began in March 1976 and is scheduled for completion in December 1983. A floating inertia block mass will be used to prevent transmission of mill vibrations. Duvha's natural draught cooling towers will be second in size only to those at Sasol Two. Concrete, reinforcement, framework, and excavation quantities are given for both the main station and the cooling towers. (Seigler-IPA)
W81-04048

SIMULATING SEAWATER INTRUSION,
For primary bibliographic entry see Field 6A.
W81-04051

MEMBRANE ENSURES DRAKENSBERG'S INTEGRITY,
For primary bibliographic entry see Field 8G.
W81-04052

A WEB OF WATER SCHEMES FOR THE THIRSTY HIGHVELD,
For primary bibliographic entry see Field 6D.
W81-04053

THE HYDRAULIC EFFECT OF FILTER MATERIALS AROUND GAPPY NON-IDEAL FIELD DRAINS,
Rothamsted Experimental Station, Harpenden (England). Dept. of Physics.
E. G. Youngs.
Agricultural Water Management, Vol 3, No 1, p 17-34, 1980. 11 Fig, 13 Ref.

Descriptors: *Subsurface drains, *Filters, *Hydraulic radius, Mathematical equations, Natural water table, Hydraulic permeability, Permeability coefficient, *Drainage programs, Drainage systems.

A general method is presented whereby bounds can be placed in the effective drain radii of gappy non-ideal drains surrounded by cylindrical filters. The mathematical solution given by Widmoser (1966) is used for drain pipes with longitudinal slits for unfiltered drains. Kirham's solution is used for drain pipes with circumferential opening. For both drain types, the effect of the filter thickness on water-table heights in drainage situations is considered. These solutions are specifically for an envelope of a filter material of uniform hydraulic conductivity surrounding the gappy drain. Upper and lower calculated bounds for the effective radius were used to calculate, by the hodograph method, lower and upper bounds for the effective maximum water-table height for parallel lines of drain pipes installed in an infinitely deep soil. It is shown that the maximum water-table height in drained land is much lower in the presence of a filter more permeable than the soil surrounding a gappy non-ideal drain. Also, a thin filter of high hydraulic conductivity relative to the soil is hydraulically more beneficial than a thicker filter of hydraulic conductivity only slightly more than that of the soil. (Small-FRC)
W81-04139

OUTFALL SYSTEMS CAN ACHIEVE SAFE EF-FLUENT LEVELS,
North Carolina State Univ. at Raleigh.
F. Y. Sorrell.
Water and Wastes Engineering, Vol 17, No 3, p 30-31, 35, 36, March, 1980. 5 Fig, 7 Ref.

Descriptors: *Outfall sewers, *Hydraulic equipment, *Flow discharge, Design criteria, Flow velocity, Flow control, Diffusion, Effluents.

An analysis of internal diffuser flow demonstrated that a desired effluent level can be attained by correct design of the layout of an outfall system. The diffuser utilizes the momentum of the discharge so as to maximize mixing between the effluent and ambient waters. If the effluent density is different from the ambient water density, the resulting buoyancy can also be used as a driving force. For optimum operation, the flow rate out of

individual diffuser ports should be uniform along the entire length of the diffuser. Also, the flow velocity in all sections inside the diffuser should be high enough to prevent deposition of any residual particles remaining after treatment. Total head loss supplied by pump energy should be as small as possible. Water intrusion should be prevented, and the diffuser should be easy to clean. Discharge velocity out of ports should be larger than the internal flow velocity, as a high discharge velocity is needed to promote mixing. Thus, the sum of all port areas downstream of any point in the diffuser must be less than the diffuser pipe area. (Small-FRC)
W81-04155

SAFETY OF RESERVOIRS,
North West Water Authority (England).

N. Hoyle.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 1, p 73-79, January, 1981.

Descriptors: *Water law, *Reservoirs, *Safety, Dam failure, Legislation, Inspection, Damage, Rupturing, Lakes, Hazards, Water storage, Flood damage, Deterioration, Operation and maintenance, United Kingdom.

British statutes concerning reservoir safety and responsibility for damages are described in the Reservoirs (Safety Provisions) Act 1930 and the Reservoirs Act 1975. The older statute is concerned with inspection requirements (every 10 years) and the records required (drawings, annual statement, and weekly water levels). The newer act requires a qualified civil engineer to continuously monitor the reservoir's safety status. Common deficiencies and defects in older reservoirs are: outlet pipes embedded in embankment or ground, not in a tunnel; no valve near the reservoir end of a draw-off pipe; insufficient means of lowering water level in an emergency; and inadequate spillway capacity. Improper maintenance can cause the following conditions: inoperable penstocks and valves, non-water-tight draw-off wells, cracks in masonry structures and tunnels, embankment settlement or deformation, seepage, and leakage. (Cassar-FRC)
W81-04224

PROPER WATER MAIN INSTALLATION,
Oklahoma City Dept. of Water, OK.

A. Blakey.
Southwest and Texas Water Works Journal, Vol 62, No 7, p 6-7, October, 1980. 4 Fig.

Descriptors: *Pipelines, *Conduits, *Trenches, Safety, *Installation, Water distribution, Water conveyance, Highways, Excavation, Ditches, Conveyance structures, *Water mains.

Proper installation of water mains starts with thorough preparation of tools and materials. Trenches are customarily dug 30 inches deep in mild climates and 6 inches below the frostline in cold climates, allowing a 6 to 12 inch clearance on each side of the pipe. Proper handling of pipe during installation involves using a hoist for lifting and avoiding dragging, rolling, and bumping the pipes. Safety and sanitary precautions must be observed. For example, careful cleaning of tools and pipes, preventing groundwater and litter from accumulating in the trench, closing pipe ends, and proper pipe sealing and sterilization. Boring is normally required at railroad crossings, major highway crossings, highways or streets, and under driveways. (Cassar-FRC)
W81-04241

DESIGNING FOR ARID CLIMATES,
Taylor (John) and Sons, London (England).

D. G. M. Roberts, and P. A. Banks.
Water and Sewage Works, Vol 127, No 1, p 59, January, 1980.

Descriptors: *Arid climates, Fouling, Odor control, Temperature effects, Waste water treatment, Hydrogen sulfide, Sand, *Design criteria, *Sewer systems.

Special problems encountered when designing sewage systems for arid locations include foul sewage and fouled processes and machinery. Sewage can reach a temperature of 35 deg C and quickly become septic. Also, low per capita water consumption makes the sewage strong and reduces flows. The resulting emission of hydrogen sulfide can cause severe corrosion of concrete and asbestos-cement pipes. Problems can be minimized by avoiding turbulence of the sewage or using forced ventilation. Also, epoxy coatings can be added to the insides of precast and in-situ concrete sewers. In areas of windblown sand, extremely efficient air filters are essential to avoid fine particle dust problems in the system. In activated sludge processes, windblown sand can enter moving machinery and cause increased bearing wear. Sand can also quickly fill small treatment lagoons. Extended aeration requires high power costs, but produces less sludge than conventional plants. (Small-FRC)
W81-04253

THE DESIGN AND CONSTRUCTION OF BAKETHIN DAM, KIELDER WATER SCHEME,
Babtie, Shaw and Morton, Glasgow (Scotland).
G. Rocke.

Journal of the Institution of Water Engineers and Scientists, Vol 34, No 6, p 493-516, November, 1980. 7 Fig, 2 Tab.

Descriptors: *Dams, *Reservoir operation, *Project planning, Water yield, *Dam design, Dam construction, Site selection, Water storage, Fisheries, Reservoir stages, Spoil disposal, Quarries, Planning, Projections, Regional development, Costs, Recreation, United Kingdom.

Bakethin Dam is a small structure that was designed for rapid construction, to regulate short term water yield from the North Tyne River and to provide amenities in conjunction with the long range water supply project, the Kielder Dam. It was constructed by the Northumbrian Water Authority on Forestry Commission lands. The history of the planning process, including costs and recreational considerations, is described. Topography, geology, hydrology, materials of construction, and meteorology are then discussed, followed by proposed and final designs. During the ten year period since the feasibility study, many of the planning considerations and the economic climate have changed. (Titus-FRC)
W81-04270

8C. Hydraulic Machinery

PELTON POWER FROM THE PAST,
S. Fiske.
Farmer's Weekly (Moheni natal), p 17, 19-21, February 27, 1980. 9 Fig.

Descriptors: *Hydroelectric plants, *Hydroelectric power, *Electric power production, *Pelton wheels, Francis reaction alysis, Legislation.

Michael Cotterell, from the Thomas River, near Cathcart in the eastern Cape, South Africa, is successfully building small-scale hydroelectric power plants. He began by redesigning the old Pelton wheel on his farm. His revision used only 680 liters/minute with a 49 m head and generated 2.2 kW, enough for his farm and home needs. He has also built plants for neighbors including a 1.3 kW, the smallest he has built to date. Most of the plants he is currently building operate at something in excess of 70% efficiency. Instead of using foundry cast cups, he now casts the wheel cups on his farm and is making them out of fiberglass. The normal machine has only five bearings and is not damaged by 'running dry'. Cotterell is also designing larger plants for villages exempt from the legislation preventing farmers from selling electricity. Farm plants of up to 15 KW are permissible and can be used wherever there is enough fall to power them. Cotterell is also working with the Francis reaction turbine, a turbine that revolves on a vertical axis like a top. Small hydroelectric power plants are cheap to install and operate and save about R1,200/year in fuel costs. (Seigler-IPA)
W81-04047

Field 8—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

FLOW AND LOAD VARIATIONS AT WASTE WATER TREATMENT PLANTS,
Ross, Saarinen, Bolton and Wilder, Fort Lauderdale, FL.
For primary bibliographic entry see Field 5D.
W81-04184

EMPLOYMENT OF SUBMERSIBLE PUMPING UNITS,
Thames Water Authority, London (England).
D. R. Dibben, and R. G. Purchase.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 1, p 59-65, January, 1981.

Descriptors: *Submersible pumps, *Pumps, *Electric motors, Instrumentation, Automation, Water conveyance, Impellers, Operation and maintenance, Corrosion control.

The 40-year history of submersible is described. Descendants of the vertical spindle pump with squirrel cage motor, the dry-winding motor and the wet-winding motor operate successfully with proper operation and maintenance. Non-corroding materials have made submersible nearly impervious to corrosion, but it is necessary to use stainless steel replacement nuts and bolts. Motor cables may use fungus-resistant sheathing such as butyl rubber, poly-chloropropylene or chlorosulfonated polyethylene. Other plastics are used for impeller and bearings. Overhaul periods suggested are 40,000 to 45,000 hours for continuously run pumps and less for on-off operation. Submersible pumps have proved reliable, with reduced building costs, better flexibility, and better mobility than conventional pumps. (Cassar-FRC)
W81-04188

8D. Soil Mechanics

SETTLEMENT OF A COMPACTED UNSATURATED EARTH EMBANKMENT,
University of the Witwatersrand, Johannesburg (South Africa).
G. E. Blight, G. H. H. Legge, and G. W. Annandale.
The Civil Engineer in South Africa (Johannesburg), Vol 22, No 2, p 25-29, February, 1980. 9 Fig, 16 Ref.

Descriptors: *Embankments, *Earth dams, *Soil mechanics, *Soil engineering, Settlement, Soil properties, Soil structures, Soil stability, Reservoirs, Mathematical models, Projections, Forecasting, *Zambia.

In 1978, twenty years after the completion of the Mita Hills dam near Kabwe, Zambia, a reanalysis of the settlement was performed using the original soil test data but more modern computational procedures. Results show that the understanding of the mechanics of unsaturated soils was poor in 1956/57 when the first settlement analysis was made. The analysis procedures used then were perfectly sound except the role of water load in producing settlement was not recognized. There are three components of settlement of an embankment of compacted unsaturated soil: (1) instantaneous compression during loading, (2) time-dependent consolidation during construction, and (3) post-construction consolidation settlement. Only post-construction consolidation settlement appears as a settlement of the crest of the embankment itself. The original settlement analysis predicted a post-construction settlement of 735 mm or 60% more than the observed settlement, if settlement resulting from water loads is discounted. The 1978 analysis over estimated the settlement by only 14%. The improved accuracy results more from computational improvements than from an increased knowledge of soil mechanics. (Seigler-IPA)
W81-04043

8F. Concrete

CARRY ON FLOATING,
Leslie (Robert) and Partners.
G. J. Van der Meulen.

Construction in Southern Africa (Johannesburg) Vol 24, No 10, p 22-24, January, 1980. 4 Fig, 1 Tab, 1 Ref.

Descriptors: *Construction methods, *Reservoir construction, *Concrete construction, *Concrete technology, *Precast concrete, Floating, Construction costs, Construction joints, Roofs, Construction materials, Erection, Water storage, Reservoir storage, Storage tanks.

A new 25 Ml capacity service reservoir was built for the Bellville Municipality using a technique first developed in 1976 for floating the concrete reservoir roof into place. The diameter of the reservoir is 63 m with a height of approximately 8 m. Construction was done by HSK Contracting at a tender price of R515,133.22, with a completion time of 11 months. HSK cast a flat slab roof on the floor of the reservoir and floated it into position on top of support columns while the reservoir was being filled for the first time. Once floated to the top, the roof was rotated through 60 degrees, lowered onto the columns, and the water drained out. The openings for the columns were sealed with precast concrete slabs. Lateral buckling was prevented by limiting movement to 15 mm in any direction. Permanent formwork was used to complete the edge of the roof slab and seal the joint between the roof and the slab. This technique allows the construction of the walls and roof to proceed space so that construction time and overhead are reduced. It also allows the owner to start using water as soon as the roof is in place, even while the last finishing touches are being made. (Seigler-IPA)
W81-04054

8G. Materials

CONVERTING ROCK TRICKLING FILTERS TO PLASTIC MEDIA; DESIGN AND PERFORMANCE,
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5D.
W81-04011

MEMBRANE ENSURES DRAKENSBERG'S INTEGRITY,

Construction in Southern Africa (Johannesburg) Vol 24, No 12, p 24-25, 27, 29, March, 1980. 3 Fig.

Descriptors: *Plastics, *Drakensberg pumped storage scheme, *Erosion control, *Tunnel linings, *Tunnel construction, Pumped storage, Electric power production, Waterproofing, South Africa, Mudstone, Concrete construction, Hypershield, Physical properties.

Approximately 26,000 sq m of non-flammable plastic membrane was used to line the two 1.5 km headrace tunnels of the Drakensberg Pumped Storage Scheme to prevent erosion of the mudstones that are found along parts of the tunnels. The tunnels are horseshoe-shaped with equivalent diameters of 6 m. Although the tunnels will be lined with concrete, cracking is inevitable and water jetting through the cracks would erode the mudstones. Various lining systems were considered and it was concluded that a plastic membrane at the rock/concrete interface would be the most effective and least expensive solution. Gundle Plastics supplied the membrane under the name Hypershield. Hypershield was manufactured in a thickness of up to 2.5 mm and in widths of up to 5.8 m so that jointing would be minimized. Hypershield is a three-ply laminate made of a 2 mm thick fleece padding that is welded between the 1.5 mm thick Orange Hypershield waterproofing membrane and the slip sheet. It has a tensile strength of 14.5 MPa with a tear strength of 104 N. Wastage was low as the membrane was supplied in predetermined lengths. (Seigler-IPA)
W81-04052

YOUR STORAGE PROBLEM'S SILVER LINING COULD BE MADE OF FLEXIBLE PVC,
For primary bibliographic entry see Field 5G.

W81-04118

FLEXIBLE MEMBRANE LININGS PROVIDE AN ENGINEERING SOLUTION,
For primary bibliographic entry see Field 5G.
W81-04119

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

THE TUG-OF-WARS IN ENVIRONMENTAL ENGINEERING EDUCATION,
T. Kish.

Journal of the Water Pollution Control Federation, Vol 53, No 2, p 143-148, February, 1981. 3 Fig, 2 Ref.

Descriptors: *Education, *Environmental engineering, Civil engineering, Industrial development, Engineering, Training, Engineering college degrees.

The number of students enrolled in graduate studies programs for water and waste water engineering decreased from 1972 to 1975 and rose slightly from 1975 to 1978. The number of undergraduates enrolled in 4-year environmental engineering programs has recently been increasing due to industrial demand. The number of advanced degrees in this field has probably declined due to withdrawal of funding for pollution control training programs. Individuals holding advanced degrees in environmental engineering are needed by both industry and the universities. Approximately 35% of all new PhD's are foreigners who return to their native countries after their degrees are complete. A report by the American Society of Civil Engineers Conference on Civil Engineering Education stated that many new engineers lack practical job skills. As the national trend for reindustrialization and updating of technological deficiencies continues, the need to educate more students in these fields will increase. (Geiger-FRC)
W81-04107

NEW FACILITIES SERVE DUAL COMMUNITY ROLE,
Camp, Dresser and McKee, Boston, MA.
For primary bibliographic entry see Field 5D.
W81-04227

LOUISIANA SEES TO TRAINING IN ADVANCE OF CERTIFICATION,
Peoples Water Service Co., Inc., Bastrop, LA. C. Porter.
Southwest and Texas Water Works Journal, Vol 62, No. 5, p 8-10, August, 1980. 3 Tab.

Descriptors: *Training, *Certification, *Water treatment, Waste water treatment, *Louisiana, Education, Organization, college courses.

Certification for water and waste water operators working in systems serving over 500 persons in Louisiana became mandatory on July 12, 1972. Training courses are available in the form of workshops, college courses, regional meetings, technical sessions, and conferences sponsored by universities and organizations. Three categories of water operators and two for waste water operators, each with four classes, were established, as well as certification requirements and examination procedures. (Cassar-FRC)
W81-04240

MONITORING DISCHARGES,
Louisiana Tech Univ., Ruston.
B. E. Price.

Southwest and Texas Water Works Journal, Vol. 61, No. 11, p 9-10, February, 1980.

Descriptors: *Training, *Analytical techniques, *Pollutant identification, Education, Louisiana, Waste water treatment, Water treatment, *National Pollutant Discharge Elimination System, Regulations, *Louisiana Tech University.

MANPOWER, GRANTS AND FACILITIES—Field 9**Education (Extramural)—Group 9A**

The substantial monitoring program specified by the National Pollutant Discharge Elimination System requires use of the analytical methods published in the December 1, 1976, Title 40, Code of Federal Regulations Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants." Personnel in Louisiana desiring training in these methods may take the Basic Laboratory Skills course developed by EPA and taught at Louisiana Tech University. This course is designed to train inexperienced personnel for chemical laboratory work. Three other courses are in the planning stages—Basic Parameters for Municipal Effluents (BOD, coliforms, pH, etc.), Nutrients (COD, N and P), and Metals Analysis (B, Cu, Fe, Hg, Na, Zn). In addition, Louisiana Tech provides water and waste water training courses for operators, plant managers, and support personnel. (Cassar-FRC)

W81-04243

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